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und des Instituts für Systematische Botanik
der Universität München

Herausgeber:
Jürke Grau · Franz Schuhwerk

Band 7 München 2001

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for their helpful comments
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Passiflora tina spec. nov., a new species of *Passiflora*, subgenus *Astrophea* (Passifloraceae) from Ecuador

R. BOENDER & T. ULMER

Abstract:
BOENDER, R. & ULMER, T.: *Passiflora tina* spec. nov., a new species of *Passiflora*, subgenus *Astrophea* (Passifloraceae) from Ecuador. – Sendtnera 7: 5–12. 2001. ISSN 0944–0178.

A new species of *Passiflora* is described from northwestern Ecuador. *Passiflora tina* R.Boender & T.Ulmer is characterized by its flowers grouped in dense fascicles, the wavy outer corona filaments surrounding the androgynophore in a campanulate fashion, the deeply cleft operculum, and the structure and length of the inner corona series. The new species is somewhat intermediate between different sections of subgenus *Astrophea* and thus questions the current classification. It most closely resembles *P. callistemma, P. maguirei* and *P. pittieri*. The differences between the four species are discussed.

Zusammenfassung:
Mit *Passiflora tina* wird eine neue Art der Untergattung *Astrophea* aus dem nordwestlichen Ecuador vorgestellt. Damit hat sich die Anzahl der in Ecuador beheimateten Vertreter der Untergattung *Astrophea* seit 1988 mehr als verdoppelt. Charakteristisch für *Passiflora tina* sind im wesentlichen die vielblumigen Blütenstände und die Struktur der äußeren Strahlenkranzreihe. Diese neue Art ist besonders eng mit *P. pittieri* verwandt und wurde zeitweise auch für diese gehalten. Eine Unterscheidung beider ist jedoch leicht möglich. Während *P. tina* einen aufrechten, glockenförmigen Strahlenkranz aufweist, liegt dieser bei *P. pittieri* hernieder. Darüber hinaus bieten die Anzahl der Elemente der äußeren Strahlenkranzreihe sowie die Menge der Blüten per Nodium eine gute Unterscheidungsmöglichkeit. Weitere verwandte Arten sind *P. callistemma* und *P. maguirei*. Von beiden kann *P. tina* mit Hilfe ihres 5-reihigen Strahlenkranzes, des breiteren Blütenkelches, sowie der im oberen Drittel stark verbreiterten Strahlenkranzelemente unterschieden werden.

Introduction

During various trips to Tinalandia, a pre-montane rain forest site on the western slope of the Andes in northwestern Ecuador, the senior author worked on the life history of *Heliconius sapho candidus* Brown (in press). This spectacular butterfly was previously very common. Its host plant and that of a closely related butterfly, *Heliconius eleuchia primularis* Butler, was in Ecuador listed as *Passiflora macrophylla* Spruce ex Mast. by BENSEN et al. (1976).

Both species of butterflies mate while the female is still in the pupal stage. These closely related species would be in competition for the same host and therefore a second host passion vine had to exist in the area, probably *P. pittieri* Mast. or something similar (Gilbert, pers. comm.). The widespread neotropical *H. sapho* feeds on *P. pittieri* in Central America.

During the 15th trip to Tinalandia in 1996, *Heliconius sapho candidus* was observed leaving a nectaring flower and circle a small area a number of times as if there were a host plant and then fly away. A search of the location revealed 3 small juvenile treelets of *P. tina*. They were growing in pre-montane rain forest on a north facing slope of about 35 to 40 degrees. The site was remarkably rich in litter of 10–15 cm deep, and the soil is typical laterite.

In culture, the treelets turned into climbing vines with well developed tendrils, which bloom about 2–3 times per year from old wood on shady parts of the plant. Remarkable is the extreme amount of nectar and the very nice odor of the flowers.

A careful examination of its characteristics and a comparison with other *Astrophea* species revealed *P. tina* differs from its close relatives, *P. callistemma* Escobar, *P. maguirei* Killip and *P. pittieri* Mast., in many characters and should be regarded as an independent species.

Passiflora tina R.Boender & T.Ulmer, spec. nov.

Type: Ecuador. Prov. Pichincha, Tinalandia, southeast of Santo Domingo de las Colorados on road to Alluriquín, 700 m, 6 May 1996, *R. Boender 744* (holotype QCA; isotype M).

Species haec in subg. Astrophea pertinens; liana; ubique ovario excepto glaberrima; petioli 0,9–1,9 cm longi; laminae foliorum integrae, oblongae, oblongae-ovatae, 7,5–30 cm longae, 3,5–10 cm latae; flores fasciculati, 6–7,5 cm diametro; coronae filamenta 5-seriata, filamentis exterioribus 2–2,8 cm longis; operculum tubulosum, erectum, supra medium irreguliter laciniatum. *Passiflora callistemma, P. maguirei* et *P. pittieri* affinis sunt.

Treelet turning into woody vine up to 9 m tall, with well developed tendrils on younger stems, glabrous throughout with exception of ovary and styles; stem terete, brown, younger parts green; stipules setaceous, 0.1–0.2 cm long, soon deciduous; petioles 0.9–1.5(–1.9) cm long, 2-glandular at junction to midrib of blade, with sessile oval nectaries ca. 0.2 cm long and 0.1 cm wide; leaves entire, oblong to oblong-ovate, (7.5–)12.5–25(–35) cm long, (3.5–)5–9(–13.5) cm wide, acute or abruptly acuminate at apex, cuneate or rounded at base, with 9–12 pairs of major lateral veins, subcoriaceous, drying olive-green; peduncles grouped in dense fascicles on old stems, 0.5–0.7 cm long; bracts subulate, 0.2–0.3 cm long; flowers 3.5–5.5 cm long, 6–7.5 cm in diameter, white with rose to purplish-brown and yellow corona; floral stipe 0.4–0.6 cm long, up to 0.3 cm in diameter; floral tube (hypanthium) cylindrical to campanulate-cylindrical, 0.8–1.2 cm long, 1–1.5 cm wide at apex, tapering towards base; sepals oblong, 2.9–4.1 cm long, 0.8–1.3 cm wide, outside green with fine darker lines, inside white tinged greenish on the edges, obtuse, fleshy; petals oblong, nearly as long as the sepals, 1–1.5 cm wide, white, membranaceous; corona in 5 series, outer series curved, forming a campanulate structure around the androgynophore, filaments of outer series (44–)47–53, laterally compressed, wavy, creme at base, purplish-orange to purplish-brown above middle and yellow at the apex, (2–)2.3–2.8 cm long, 0.2 cm wide at base, abruptly dilated in upper third, 0.4 cm wide, tapering to apex, ca. 0.1 cm wide, filaments of second series laterally compressed, 0.9–1.3 cm long, dilated up to 0.2 cm near apex, creme to yellow at base, tinged more and more purple above middle, those of third series laterally compressed, 0.6–0.8 cm long, about 0.1 cm wide, purplish-orange to purplish-brown, those of fourth series filiform, about 1cm long, inserted inside the hypanthium, curled in lower third, erect in upper half, those of inner series narrowly linear, about 0.5 cm long, placed 0.3 cm above base of oper-

culum; operculum inserted slightly above middle of hypanthium, tubular, erect, exserted above apex of hypanthium, irregulary cleft in upper half, 1–1.5 cm long, reddish; androgynophore 3–3.5 cm long, reddish; ovary ovoid, ca. 0.5 cm long, ca. 0.3 cm wide, densely pubescent; styles ca. 1 cm long and 0.2 cm wide, densely pubescent; fruit unknown.

Additional collection examined:

Ecuador. Prov. Esmeraldas: Bilsa Reserve, Green Trail, Station 35, 559 m, 6 Aug 1998, *D.D. Kapan & S. Delgados 125* (TEX).

Taxonomic remarks

Passiflora tina belongs to the subgenus *Astrophea*, but it does not fit well into any of the six sections given by KILLIP (1938) and taken on by ESCOBAR (1994). The new species is intermediate between the sections *Dolichostemma* Killip (exserted, tubular operculum), *Pseudoastrophea* (Harms) Killip (morphology of the flowers, especially the corona) and *Botryastrophea* (Harms) Killip (flowers in dense fascicles, cauliflorous) and thus questions the current classification. KILLIP (1948) mentioned the same problems with *P. maguirei*, which he placed next to *P. deficiens* Mast. of section *Pseudoastrophea*. ESCOBAR (1994) described *P. callistemma* a species characterized by its white flowers in dense fascicles, a short hypanthium and an exserted operculum. She indicated that *P. callistemma* closely resembles *P. ovata* Martin ex DC of section *Pseudoastrophea*, which also has an tubular operculum. There is at least one more species of subgenus *Astrophea*, *P. haughtii* Killip, which has a tubular operculum around the androgynophore with its margin above apex of hypanthium.

On the basis of these findings, it seems to be necessary to question whether the long, tubular operculum should be regarded as a distinctive mark of section *Dolichostemma*. However, further studies are required to establish whether the current circumscription the sections are monophyletic entities. We are anxiously looking forward to the revision of this subgenus begun by Escobar and to be completed by Hansen in the near future.

Passiflora tina is closely related to *P. callistemma* from northwestern Colombia, *P. maguirei* from British Guiana, Brazil and probably Venezuela, and the widespread *P. pittieri* which is known from Belize, Costa Rica, Panama, Colombia and Venezuela. JØRGENSEN & MACDOUGAL (1997) mentioned that *P. pittieri* occurs also in Ecuador.

Using ESCOBAR's key to subgenus *Astrophea* (1994) it key out as *P. callistemma*. In the Flora of Ecuador HOLM-NIELSEN et. al. (1988) it does not fit in the key of subgenus *Astrophea*, because only four species not resembling *P. tina* were known. *P. tina* differs from *P. callistemma* and *P. maguirei* by having 5 corona series, a wider hypanthium and strongly dilated corona filaments of outer, second and third series. From *P. pittieri*, the new species can be distinguished by its flowers borne in dense fascicles, shorter peduncles, the wavy outer corona series which is forming a campanulate structure around the androgynophore, and the higher number of the strongly dilated outer corona filaments. The differences between the four species are summarized in Table 1.

Etymology

The epithet honors Tina Garzon who was born in Odessa. She fled the Russian Revolution in the early part of the 20th century and built the Tinalandia hotel located next to a small forest and an adjoining tract which are about the only forest left in this part of Ecuador. Tina recently died at about 88.

We thank Dr Thomas Emmel at the University of Florida for introducing the senior author to the country of Ecuador and his letters of support. We thank Dr Lawrence Gilbert at the University of Texas for the inspiration to study Passifloras and Heliconius butterflies. We thank John MacDougal at the Missouri Botanical Gardens for the constant encouragement to keep going in our search and promotion of this plant family. We thank Dr Alberto Padilla and Dr William Patricio Ponce at the Catholic University in Quito, Ecuador for their invaluable help in sponsoring and obtaining permits to bring this material back for more detailed study. We thank the people at INEFAN for granting the permits that allowed us to study their natural resources. We thank Dr Durrell Kapan of the University of Texas for his helpful information and photographs of *P. tina* from Bilsa Reserve location. Finally we are grateful to Dr Peter Møller Jørgensen for his constructive criticism on this manuscript.

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Table 1. Comparison of *Passiflora tina* and its closest relatives.

Characteristics	*P. callistemma*	*P. maguirei*	*P. pittieri*	*P. tina*
Number of flowers/node	paired or grouped in fascicles, 2–8 flowers/node	grouped in dense fascicles, about 5 flowers/node	peduncles solitary, often bifurcate, usually 1–2 flowers/node	grouped in dense fascicles, 4–10 flowers/node
Length of peduncles including floral stipe	1.4–2.3 cm	1.6–2 cm	1.4–6.1 cm	0.9–1.3 cm
Hypanthium	cylindrical, ca. 0.9 cm long, ca. 0.6 cm wide	funnel shaped, 1.5–2 cm long, ca. 0.8 cm wide	cylindric-campanulate, 0.8–1 cm long, 0.6–0.7 cm wide	cylindrical to campanulate-cylindrical, 0.8–1.2 cm long, 1–1.5 cm wide at apex
Number of corona series	4	4	4–5	5
Outer corona series	wavy, surrounding the androgynophore in a campanulate fashion	probably not wavy, probably more or less flat	not wavy, more or less flat	wavy, surrounding the androgynophore in a campanulate fashion
Number, length and form of outer corona filaments	ca. 65, ca. 3 cm long, very slender	number unknown, 2–2,2 cm long, linear-dolabriform, 0.2 cm at widest point	28–37(–42), 1.5–2 cm long, sub-dolabriform, 0.2 cm at widest point	(44–)47–53, (2–)2.3–2.8 cm long, abruptly dilated in upper third, up to 0.4 cm at widest point
Filaments of second series	ca. 0.5 cm long, dilated at apex	ca. 1 cm long, narrowly linear	0.5–0.8 cm long, dilated, 0.1 cm wide at apex	0.9–1.3 cm long, dilated up to 0.2 cm near apex
Operculum	ca. 1 cm long	ca. 1.2 cm long, deeply cleft in upper half	ca. 1 cm long, minutely denticulate	1–1.5 cm long, deeply cleft in upper half

Ronald BOENDER, Butterfly World, 3600 West Sample Road, Coconut Creek, FL 33073, U.S.A.
Torsten ULMER, Universität Essen, Fachbereich 9/Botanik, 45117 Essen, Germany.

Figure 1: a: Flowers of *Passiflora tina* R.Boender & T.Ulmer grouped in dense fascicles (*Boender 744*, cultivated); b: Flower, close up showing the corona series; c: *Heliconius sapho candidus* Brown.

Figure 2: Habit of *Passiflora tina*.

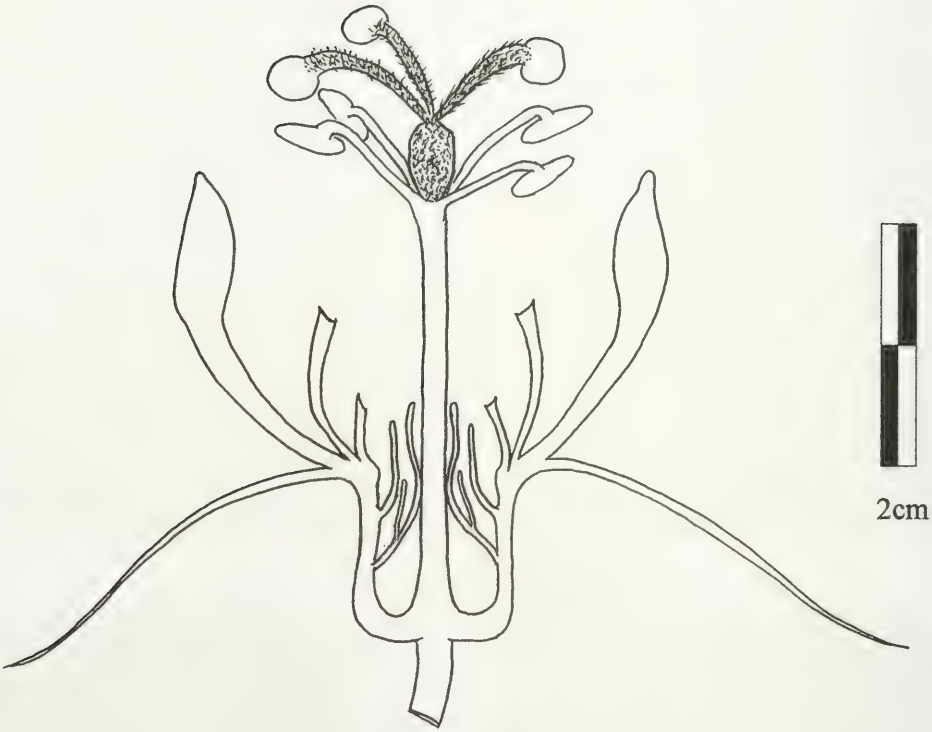


Figure 3: Schematic detail of longitudinal section through the flower of *Passiflora tina*.

Achene hairs and their diversity in the genus *Chaetanthera* Ruiz & Pav. (Mutisieae, Asteraceae)

A.M.R. DAVIES & E. FACHER

Summary:
DAVIES, A.M.R. & FACHER, E.: Achene hairs and their diversity in the genus *Chaetanthera* Ruiz & Pav. (Mutisieae, Asteraceae). – Sendtnera 7: 13–33. 2001. ISSN 0944–0178.

A detailed and comprehensive survey of the achenes belonging to 35 of the 42 accepted species of the South American genus *Chaetanthera* Ruiz & Pav. revealed new micro-morphological characters. In particular the achene hairs yielded important and taxonomically significant characters. Three achene hair types were distinguished: "Zwillingshaare" (in various forms), filiform hairs, and single-celled papillae. Glabrous achenes were also recorded; the lack of achene hairs was species specific and, not unexpectedly, was not a useful discriminator for bigger groups. Within a species the hair types were consistent. The diversity of hair types and their distribution throughout the genus was compared to the traditional sub-generic structure proposed by CABRERA (1937). The achenes of those taxa belonging to the current subgenera *Proselia*, *Euchaetanthera*, *Tylloma* and *Glandulosa* are never glabrous and have very similar "Zwillingshaare" (90–120 µm long, obovate to elliptic or lanceolate in outline). Achenes of the subgenus *Oriastrum* show consistent variations of spherical or conical-deltoid "Zwillingshaare" (10–50 µm in length) while achenes of taxa in the subgenus *Carmelita* are glabrous or have tiny (7–15 µm in length) spherical "Zwillingshaare". Achenes of the subgenus *Egania* are mostly glabrous, with a couple of taxa showing single-celled papillae thereon, and two taxa long filamentous (but not "Zwillingshaare") hairs (approx. 450 µm in length). Based on the hair types, clear divisions within the genus can be seen. However these need to be supported by correlating characters. A revision of the genus *Chaetanthera* is currently in progress.

Zusammenfassung:
Eine detaillierte und umfassende Untersuchung der Achänen von insgesamt 35 der 42 akzeptierten Arten der südamerikanischen Gattung *Chaetanthera* Ruiz & Pav. zeigt neue mikromorphologische Merkmale auf. Insbesondere die Achänenhaare liefern wichtige und für die Taxonomie verwertbare Merkmale. Drei grundlegende Achänenhaartypen können unterschieden werden: Zwillingshaare (in verschiedenen Formen), filiforme Haare und einzellige Papillen. Relativ häufig treten kahle Achänen auf; das Fehlen von Haaren ist artspezifisch, faßt jedoch, wie zu erwarten, keine größeren Gruppen zusammen. Innerhalb einer Art sind die auftretenden Haartypen einheitlich. Die Verteilung der Haartypen innerhalb der Gattung wird mit der von CABRERA (1937) vorgeschlagenen Unterteilung verglichen. Dabei ergibt sich folgendes Bild: Bei den in den Untergattungen *Proselia*, *Euchaetanthera*, *Tylloma* und *Glandulosa* zusammengefaßten Arten sind die Achänen nie kahl und weisen große Ähnlichkeit in den

Zwillingshaaren auf: Elliptisch oder lanzettförmig mit einer Länge von 90–120 µm. Die Arten der Untergattung *Oriastrum* tragen auf den Achänen kugel- oder kegel- bis deltaförmige Zwillingshaare mit einer Länge von 10–50 µm. Die Achänen der Arten der Untergattung *Carmelita* sind kahl oder besitzen kleine, kugelförmige Zwillingshaare mit einer Länge von 7–15 µm. Die Arten der Untergattung *Egania* haben überwiegend kahle Achänen mit Ausnahme von zwei Arten mit einzelligen Papillen auf den Achänen und zwei weiteren Arten mit filiformen, bis zu 450 µm langen Haaren (keine Zwillingshaare). Aus diesen Ergebnissen kann der Schluß gezogen werden, daß aufgrund der auf den Achänen gefundenen Haartypen eine deutlichere Gliederung der Gattung vorgenommen werden kann. Es ist jedoch notwendig, diese durch zusätzliche Merkmale zu stützen. Eine komplette Revision der Gattung *Chaetanthera* ist in Bearbeitung.

Introduction

Achene characters are often used to taxonomic advantage in many genera of the Compositae, (OBERPRIELER 1998, VINCENT 1996, ROMMEL 1979). Of particular interest is the ornamentation of the pericarp epidermal cells – that is the surface characters of the fruit bodies. It has been said that while using ultrastructure features can be useful in establishing concepts, they cannot be used as key characters (KING & ROBINSON, 1970). Nevertheless micromorphological characters are often studied as generic markers in the Asteraceae. In some cases they are found to obscure generic relationships (Astereae, SUNDBERG, 1985), but equally so, micro-morphological characters can be both useful and consistent markers for generic delimitation (LANE 1985, SCOTT 1985).

1. Infra-generic taxonomy

The predominantly Chilean genus *Chaetanthera*, first described in 1794 by RUIZ and PAVÓN, now circumscribes approximately 40 species. The most recent revision by CABRERA (1937) divided the genus into seven subgenera. The defining generic character linking these species is said to be the possession of a winged membrane on the margins of the phyllaries, the outer series of which are foliaceous. The subgenera are distinguished by characters including capitulum size, ornamentation of the apices of the inner series of phyllaries, style arm dimensions, leaf shape, habit, life cycle and achene pubescence (after CABRERA, 1937). Table 1 below summarises the subgenera structure of *Chaetanthera* proposed by Cabrera and the species included in this study.

Since the 1937 revision was published five new taxa have been described: *Chaetanthera chiquianensis* Ferreyra, *C. boliviensis* J.Kost., *C. aymarae* Martic. & Quezada, *C. leptocephala* Cabrera, and *C. perpusilla* (Wedd.) Anderb. & Freire (the last solely distinguished from *Chaetanthera* by the presence of papillose hairs on the achenes). With the exception of *C. boliviensis*, these are broadly included in the subgenus "*Euchaetanthera*". None of these were analysed here, and neither were examples of *C. australis* Cabrera, *C. brachylepis* Phil. or *C. flabellifolia* Cabrera.

2. Inter-generic taxonomy

Chaetanthera has two putative sister genera – *Pachylaena* D.Don (distinguished by having a plumose pappus) and *Brachyclados* Hook. & Arn. (distinguished by having non-foliaceous external phyllaries, pappus arrayed in 3–4 series and shrubby with ± pedunculate capitulae). These two very small genera have not been revised since the 1830s. Examples of *Pachylaena atriplicifolia* Hook. & Arn., *Brachyclados lycioides* D.Don and *B. megalanthus* Speg. were observed with a view to their potential for outgroup comparison.

Table 1: Summary of the traditional infra-generic structure sensu CABRERA (1937) of *Chaetanthera* including only the taxa that were surveyed. (Author names after BRUMMITT & POWELL, 1992)

Subgenus	Species names	
Glandulosa	*C. glandulosa* Remy	
Egania	*C. acerosa* (Remy) Benth. & Hook.f. *C. apiculata* (Remy) F.Meigen *C. cochlearifolia* (A.Gray) B.L.Rob. *C. dioica* (Remy) B.L.Rob. *C. pentacaenoides* (Phil.)Hauman	*C. pulvinata* (Phil.) Hauman *C. revoluta* (Phil.) Cabrera *C. sphaeroidalis* (Reiche) Hicken *C. stuebelii* Hieron.
Oriastrum	*C. lycopodioides* (Remy) Cabrera *C. gnaphalioides* (Remy) I.M.Johnst. *C. minuta* (Phil.) Cabrera	*C. planiseta* Cabrera *C. pusilla* (D.Don) Hook. & Arn.
Carmelita	*C. villosa* D.Don *C. lanata* (Phil.) I.M.Johnst.	*C. spathulifolia* Cabrera
Tylloma	*C. glabrata* (DC.) F.Meigen *C. limbata* (D.Don) Less.	*C. renifolia* (Remy) Cabrera *C. splendens* (Remy) B.L.Rob.
Proselia	*C. elegans* Phil. *C. chilensis* (Willd.) DC.	*C. serrata* Ruiz & Pav. *C. valdiviana* Phil.
Euchaetanthera	*C. ciliata* Ruiz & Pav. *C. euphrasioides* (DC.) F.Meigen *C. flabellata* D.Don *C. incana* Poepp. *C. linearis* Poepp.	*C. microphylla* (Cass.) Hook. & Arn. *C. moenchioides* Less. *C. peruviana* A.Gray *C. tenella* Less.

3. Achene hairs in the Compositae – morphology and importance

The description and publication concerning the hairs seen on the fruits of the Compositae has been accepted for many years. Although typified by HANAUSEK (1910), HESS (1938) wrote the seminal paper on the typical trichomes unique to the Compositae. They are named "Zwillingshaare" (twin hairs).

Achenes and often their hairs have frequently proven to be fundamentally useful indicators of generic and subgeneric relationships (*Felicia*, GRAU 1973; *Amellus*, ROMMEL 1979; *Grangea*, *Grauanthus* and *Dichrocephala*, FAYED 1979; *Gerbera*-complex, JEFFREY 1967, HANSEN 1989; *Anthemis* L., OBERPRIELER 1998), or even tribal distinctions (DITTRICH, 1985, 1996) in the Astereae. VELEZ (1981) demonstrated that some genera (of the American Asteraceae) have unique hairs, while in other cases several genera can share one hair type. One advantage of using achene characters, and in particular the hairs, is that they are considered to be independent of environment (Grau, pers. comm.). Therefore the variation expressed in these characters forms a source of reliable taxonomic indicators.

The presence or absence of achene hairs has been pivotal to the keying out of the seven subgenera of *Chaetanthera* in the past. CABRERA (1937) recognised two achene hair types - papillose and seriaceous-villous, as well as glabrous achenes. HANSEN (1991) noted the presence of both hairy and glabrous achenes in the genus, the former carrying either of two hair types: inflated and tapering, or orbicular. The aim of this study was to establish on a firm basis the existing variation in the achenes and whether this variation might have taxonomic implications.

Methods

Over 650 specimens of the genus *Chaetanthera* were received from the herbaria of GH, K, M, NY, P, W (abbreviated after HOLMGREN et al., 1990) and the private collections of Prof. J. Grau and Dr C. Ehrhart. Nearly 200 collections of 35 *Chaetanthera* species (covering all seven subgenera), 1 species of *Pachylaena*, and 2 of *Brachyclados* were sampled. Citations for typical material observed can be found in Appendix 1. Achenes from both ray and disc flowers were carefully extracted from the herbarium material and placed directly, without further treatment on carbon-coated stubs. These were then sputtered with platinum using a Bal-tec sputterer. Digital images were taken under a high vacuum using a LEO 483VP Scanning Electron Microscope (SEM) at both low and high magnifications.

Using these images the achenes were assessed for 51 characters covering 6 quantitative measures and 45 features including achene shape, achene surface, achene hair shape and construction, and 5 pappus characters.

Results

1. SEM observations and images

During this study three factors indirectly related to the research became apparent. These were the effect of collection age on sample quality, the consistency of achene surface structures relative to maturity and, perhaps most importantly, the SEM focus error.

1.1. Specimen age

The age of the herbarium specimens, with only few exceptions, did not contribute to, or detract from, the quality of achene hair preservation. One of the more distressing features of some specimens was the abundance of hyphal growth obscuring the characters of interest. The disintegration of some features has been attributed to environmental conditions at the time of collection. Only one taxon showed a tendency to have fused achenes – *C.villosa*.

1.2. Mature and immature or sterile achenes

The maturity of the achenes is a difficult parameter to quantify without precise glasshouse surveys. However, casual observation shows that the maturity and fecundity of the achenes particularly affects the size and shape of the achenes, but does not seem to alter the presence, or type, of hairs. As seen in one collection, an achene can increase in length by 30% and in width by 60% as it matures, while the changes in hair dimensions are negligible.

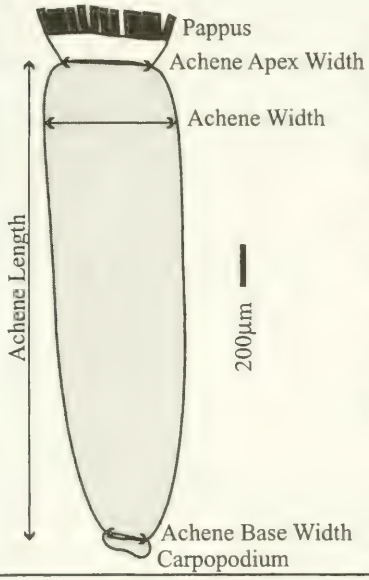
1.3. Focus error

Unusually for SEM observations, the total size of the material samples was sometimes quite large (> 4.00 mm). As a result, it was not always possible to have the complete object entirely in focus, affecting the apparent length of the object. The mean error for large achenes over 2.35 mm in length was calculated at 2.4% of the length. The greatest error was measured for the largest achenes, but rapidly tails off as the general size of the achene shrinks, and the error becomes almost negligible for achene lengths below 2.35 mm (0.4%).

2. Within the genus *Chaetanthera* – quantitative characters

Six quantitative characters were observed. These were achene length and width, achene apex width, achene base width, and achene hair length and width. The measurements of the various dimensions were taken using the guidelines shown in Plate 1 (Figs. 1–2). The Log_{10} values of each character were plotted in rank order, with the graphs drawn to the same scale so that each character could be easily compared (see Graphs 1–4).

Fig. 1: Location from which the quantitative measurements on the whole achene were taken.



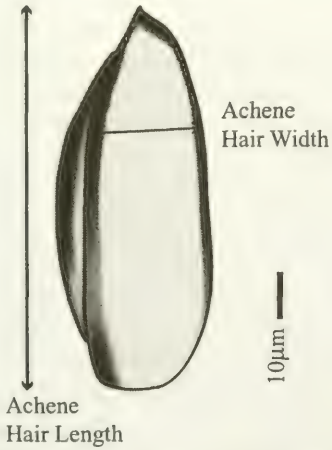
Achene Length: The length of the achene taken from the longest axis from the pappus insertion (apex) to (but not including) the carpopodium (base).

Achene Width: taken from the widest point (perpendicular to the long axis) of the fruit.

Achene Apex Width: taken from below the pappus insertion.

Achene Base Width: taken from the where the carpopodium and fruit meet. When no carpopodium is present, the base width is taken from the homologous region.

Fig. 2: Location from which the quantitative measurements on the achene hairs were taken.



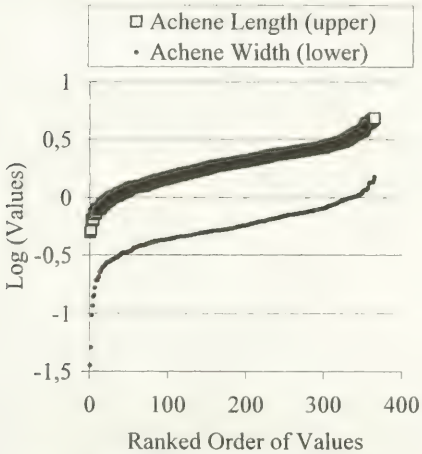
Achene Hair Length: the length is taken parallel to the central cell wall of the 'twin hairs', always from the point where the hair is inserted in the pericarp epidermis.

Achene Hair Width: taken from the widest point across the hair perpendicular to the long axis.

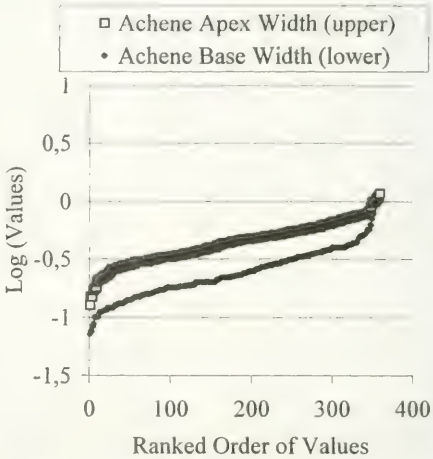
N.B. This figure is adapted from an image of a 'twin hair' of the species *C. linearis*.

Plate 1: Images showing measuring planes used to collect the qualitative information from the achenes and their hairs (when present).

2.1. Achene length and width: Achene length varies from 0.5 mm (*C. pusilla*) to 4.8 mm (*C. lanata*). The achene widths vary from 0.04 mm (*C. linearis*, immature) to 1.51 mm (*C. villosa*). Achene lengths and widths are continuously distributed in this sample (Graph 1).
2.2. Achene apex and base widths: The apex widths vary from 0.13 mm (*C. linearis*) to 1.17 mm (*C. spathulata*). Achene base widths vary from 0.07 mm (*C. gnaphalioides*) to 0.79 mm (*C. villosa*). The measurements are continuously distributed in this sample (Graph 2). Although there are no discrete groupings, there is still a significant variation by over a factor of ten in achene length and width as well as achene apex and base widths across the data set. In all four cases the linear distribution (see Graphs 1–2) is approximately y = 0.002x, indicating that each quantitative character exhibits similar variation. Thus we deduce that all of these four characters (achene length and width, and achene apex and base width) are equally useful for analysing the data, even though they do not show clear evidence of clustering.

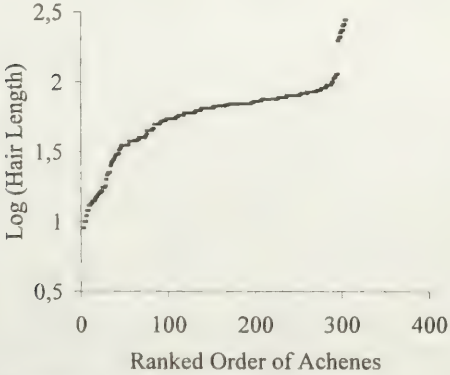


Graph 1: Ranked Order of Log (Achene Length) & Log (Achene Width)

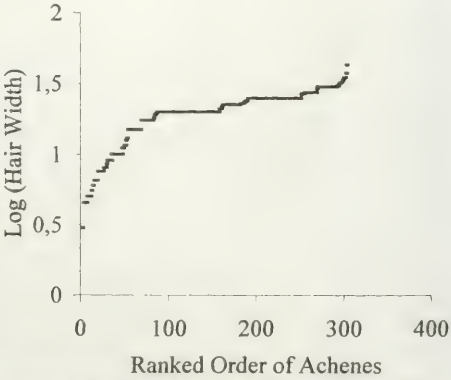


Graph 2: Ranked Order of Log (Achene Apex Width & Achene Base Width)

2.3. Achene hair length and width: When hairs are present on the achenes they can vary from 10 µm to over 450 µm in length. The hairs vary in width from 5 µm to 75 µm. Graphs 3 and 4 have comparatively less smooth, flatter curves, with much bigger tails, particularly at the lower end. They both vary in the same way, the flat part indicating that for about half the achenes, the size of achene hairs is not a good discriminator.



Graph 3: Ranked Order of Log (Achene Hair Length)



Graph 4: Ranked Order of Log (Achene Hair Width)

However, the dramatic tails on the graphs indicate that for large and small extremes hair size, particularly length, becomes an increasingly valuable discriminator. Plotting a linear regression on these curves would not be useful, as it would only apply to about half the sample.

Quantitative characters like these that indicate some clustering, together with those which show less clear patterns of segregation, can be combined to be more informative. We have plotted the Log_{10} values of achene lengths and achene hair lengths against each other (Graph 5). A third qualitative character, achene hair shape, is also represented on the plot. Glabrous achenes are included for illustrative purposes. The various hair types (see qualitative characters) are represented by different symbols. We can see that the 4 hair types have broad hair length distributions. Three obvious bands of hair lengths are seen which correlate with the following hair shapes; filiform, globular and obovate-lanceolate. The glabrous achenes show a similar broad distribution along the x-axis.

Graph 5 indicates that for nearly the same wide range of achene lengths it is possible to have hairs or no hairs. When present the length of these hairs is really tightly associated with their shape. Thus globular hairs are always, in this data set, much shorter in length than any of the obovate-lanceolate hairs. These are in turn always shorter than the filiform hairs. Graph 5 clearly demonstrates that achene hair length and shape are, to some extent, correlated. Furthermore, the hair shape allows the data set to be divided into discrete clusters that were not apparent from the hair length distribution alone.

3. Within the genus *Chaetanthera* – qualitative characters

Qualitative characters of the achenes included shape, cross-section, apical morphology, and surface ornamentation and, for the achene hairs, types, orientation and features. Achene shape varied from pyriform, turbinate, fusiform to oblong, and in cross-section from compressed, terete, semi-terete or triangular. The angles in cross-section can be rounded and shallow, or prominent and sharply angular. The pericarp epidermal cells were classed as parenchymatous, subisodiametric, papillate, striate, centrally depressed or having no surface sculpture.

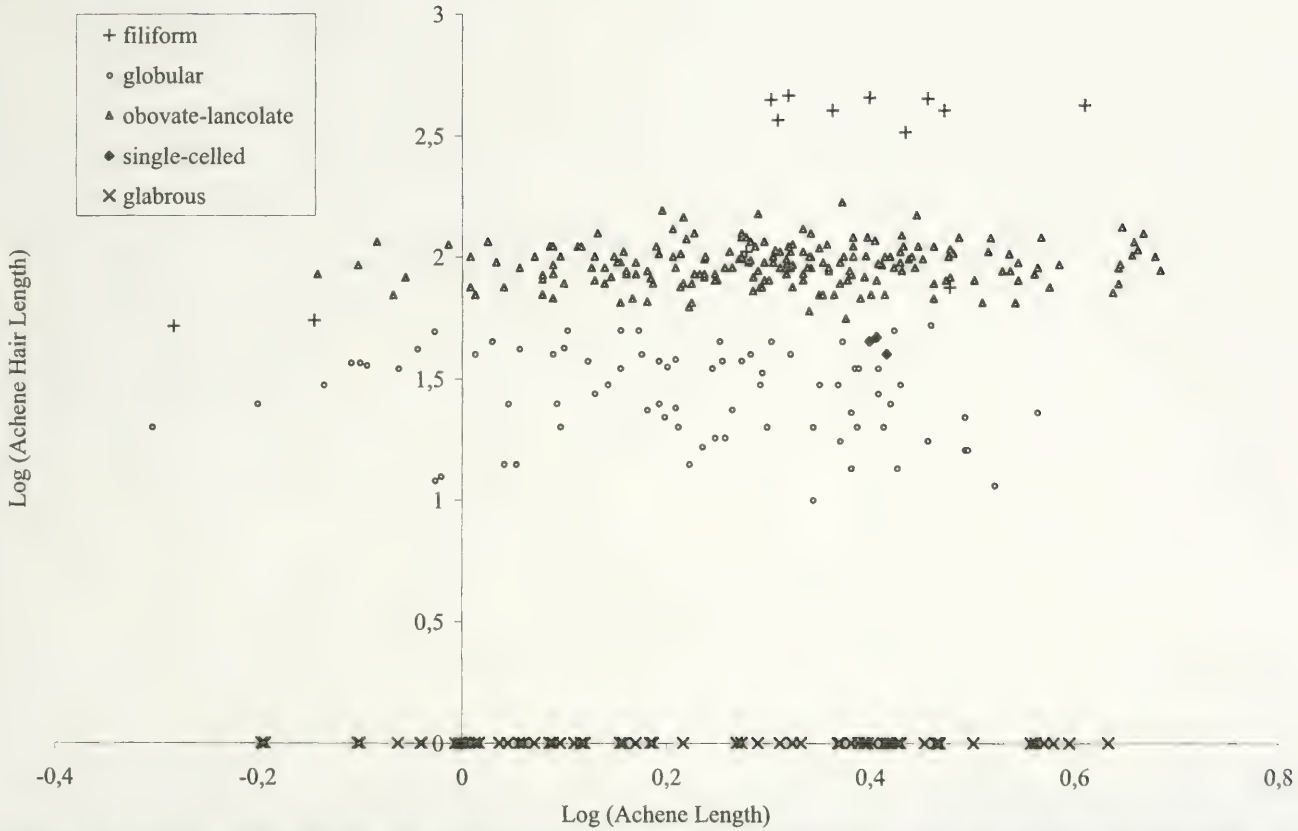
The achene hairs when present were 1-, or 2-celled (parallel or stacked) and displayed a range of shapes (after STEARN, 1995) lanceolate or elliptic, to very small globular, conical or ampulliform hairs, long filiform hairs (RAMAYYA, 1962), or papillae (METCALFE & CHALK, 1979). The tips varied from obtuse or acute and mucronate or apiculate, sometimes shortly bifurcated, rarely depressed. They were variously found to be erect to appressed, and either deflated or inflated (symmetrically or asymmetrically) about the horizontal axis. They covered the achenes sparsely to densely.

Achene hairs were recorded in 30 different species. Within these, three basic hair types were identified: "Zwillingshaare", filiform hairs and single-celled papillae. The variation is outlined below and the species placements are given in Table 3. The achene hairs were found to be mostly consistent in both shape and size within species (i.e. between collections).

3.1. "Zwillingshaare"

3.1.1. Obovate elliptic to lanceolate or rarely naviculate

These hairs are large, varying in length from (80)–90–120–(130) µm. This hair type is associated with a relatively featureless epidermal surface. The 17 species with these sorts of hairs (*C. chilensis, C. ciliata, C. elegans, C. glabrata, C. glandulosa, C. incana, C. lanata, C. limbata, C. linearis, C. microphylla, C. moenchioides, C. peruviana, C. renifolia, C. serrata, C. splendens, C. tenella,* and *C. valdiviana)* generally have hairs on both the disc and ray achenes, and are very rarely nearly glabrous. This is the most common hair type in *Chaetanthera* and it shows so much variation that it is seldom possible to distinguish collections of species without practice. The extremes of variation in this group of hairs are illustrated with images that can be seen in Plate 2 (Figs. 3–10).



Graph 5: Log (Achene Length) against Log (Achene Hair Length), with different achene hair types denoted according to symbols in key.

3.1.2. Spherical (to rarely conical)
Seven species fall into this category. The hairs are smaller but consistently spherical, vary in length from 8–50 µm, and can be subdivided into 3 sections. In *C. planiseta* and *C. pusilla* (section 3.1.2.a.) the hairs are found on both disc and ray achenes and, while often deflated to some extent, have a distinctly thickened cell wall. The length of these hairs varies from 35–50 µm (Plate 3, Fig. 15). Section 3.1.2.b. includes three taxa (*C. euphrasioides, C. flabellata* and *C. lycopodioides)*. The hairs have an indistinct dividing cell wall, in some cases tending towards conical rather than spherical in outline, and in one species the ray achenes are often glabrous The hair length measures between 20–40 µm (Plate 3, Figs. 11–14). Lastly *C. lanata* and *C. spathulifolia*, distinguished as section 3.1.2.c., possess spherical hairs that vary from 7–15 µm and are sparsely distributed over the surface. They are however frequently poorly preserved. In these cases the achenes can appear to be glabrous (Plate 3, Fig. 16).
3.1.3. Ampulliform to nearly deltoid
Only two species belong to this group - *C. gnaphalioides* and *C. minuta*. These hairs can be found with an occasional recurved, rostrate apical tip and may or may not appear to be collapsed. The hairs vary in length from 7–20 µm. These images can be seen in Plate 3, Figs. 17–18.

3.2. Filiform hairs
Only two species (*C. apiculata* and *C. acerosa*) possessed these hairs. The long, filamentous, seriaceous-villous hairs are constructed of two vertically stacked cells; one short basal cell, and the second, elongated apical cell. They have an approximate length of 450 µm. Some collections of the two species can be completely glabrous. No correlation to disc and ray distribution was observed. Filiform hairs confined to a sparse ring near the pappus insertion were only rarely recorded (two samples, not *C. apiculata* and *C. acerosa*). Their cell construction remains unclear, but it seems most likely that they are an artefact of the pappus morphology rather than an achene epidermal character. Plate 4, Fig. 23. illustrates the filiform hairs.

3.3. Single-celled papillae
Single-celled papillae were only found in a couple of species *(C. pulvinata* and *C. revoluta)*, the oblate flattened hairs densely covering the achenes, and with a mean length between 25–45 µm. These images can be seen in Plate 4, Figs. 21–22.

3.4. Glabrous achenes within the genus *Chaetanthera*
Twelve *Chaetanthera* species had glabrous achenes. Half of these were consistently glabrous both within and between capitula of the same and different collections. These were *C. cochlearifolia, C. dioica, C. pentacaenoides, C. pulvinata, C. sphaeroidalis*, and *C. stuebelii*. These achenes had the most interesting epidermal surfaces; for example the image shown on Plate 4, Fig. 19. Further, these taxa are arranged in the same sub-genus "*Egania*". In six taxa (*C. acerosa, C. apiculata, C. lanata, C. minuta, C. revoluta,* and *C. villosa)* combinations of both glabrous and pubescent achenes in collections of the same species were observed. These did not follow any set pattern, nor do the species concerned come from the same group of taxa. The epidermal surfaces in these cases were relatively featureless (Plate 4, Fig. 20.). The varying combinations of glabrous and pubescent achenes within and between collections of the same taxa are presented in Table 2.

Table 2: Table summarising combinations of glabrous (-) and pubescent (+) achenes in collections of the same species.

Taxa	Ray floret	Disc floret
3 (*C. acerosa, C. lanata, C. minuta)*	-	-
	+	+
2 (*C. villosa, C. revoluta*)	Not observed	-
	Not observed	+ (rare)
1 (*C. apiculata*)	+	+
	-	-
	-	+ (rare)

4. Between the genera – *Pachylaena* and *Brachyclados*

Pachylaena and *Brachyclados* were also studied. *Pachylaena atriplicifolia* was represented by 2 collections. The first had only glabrous achenes, while the second possessed small (20–35 µm L.) lozenge-shaped achene hairs – again, twin-celled (see Table 3, section 3.1.4.). They were however, sparsely distributed, and rather poorly preserved.

Brachyclados lycioides material possessed both long (120–175–(200) µm in length) oblate-lanceolate "Zwillingshaare" (section 3.1.5.), and shorter (25–45 µm in length) globular hairs (Table 3, section 3.1.2.a.) *B. megalanthus* only had the former hair type, but marginally smaller in length (80–130 µm). The results are pictured in Plate 4, Figs. 24–26.

5. Summary of results

The information in Table 3 presents a summarised view of the achene hair types, which species carry these hair types, and to which subgenus these species are traditionally ascribed. The section numbers given in Table 3 correspond mostly to the section numbers in the text.

Table 3: Summary table showing achene hair type and the species (and subgenera) which carry these types. (*indicates which species are illustrated in this paper)

Hair Type			Taxon Names - Subgenus [Species]
3.1. "Zwillingshaare"	1.		*Proselia* [*C. chilensis*, C. elegans, C. serrata, C. valdiviana*] *Euchaetanthera* [*C. ciliata*, C. incana*, C. linearis, C. microphylla*, C. moenchioides*, C. peruviana, C. tenella*] *Tylloma* [*C. glabrata, C. limbata*, C. renifolia*, C. splendens*] *Glandulosa* [*C. glandulosa**] *Carmelita* [*C. lanata (?)*]
	2.	a	*Oriastrum* [*C. planiseta, C. pusilla**] *Brachyclados lycioides*
		b	*Oriastrum* [*C. lycopodioides**] *Euchaetanthera* [*C. euphrasioides*, C. flabellata**]
		c	*Carmelita* [*C. lanata, C. spathulifolia**]
	3.		*Oriastrum* [*C. gnaphalioides*, C. minuta**]
	4.		*Pachylaena atriplicifolia**
	5.		*Brachyclados megalanthus*, B. lycioides**
3.2. Filiform			*Egania* [*C. acerosa*, C. apiculata*]
3.3. Papillose			*Egania* [*C. pulvinata*, C. revoluta**]
3.4. Glabrous			*Egania* [*C. acerosa*, C. apiculata, C. cochlearifolia, C. dioica, C. pentacaenoides, C. pulvinata, C. revoluta, C. sphaeroidalis*, C. stuebelii*] *Carmelita* [*C. lanata, C. villosa*] *Oriastrum* [*C. minuta*] *P. atriplicifolia*

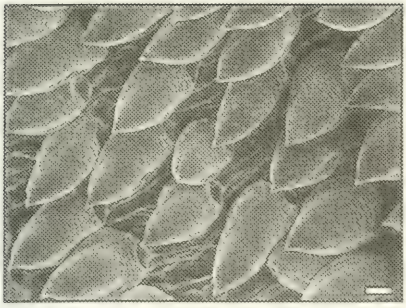


Fig. 3: bar 20μm

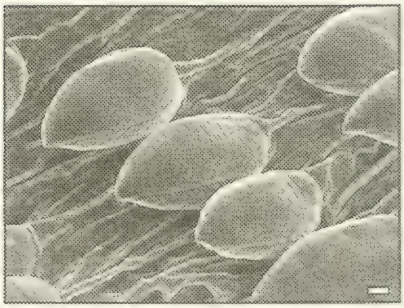


Fig. 4: bar 10μm

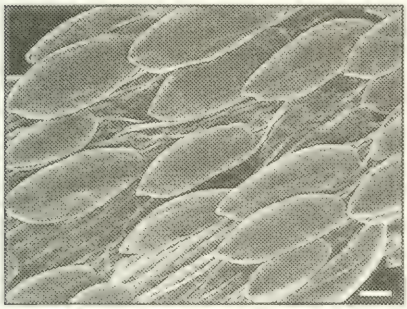


Fig. 5: bar 20μm

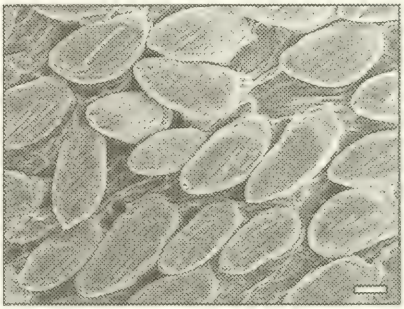


Fig. 6: bar 30μm

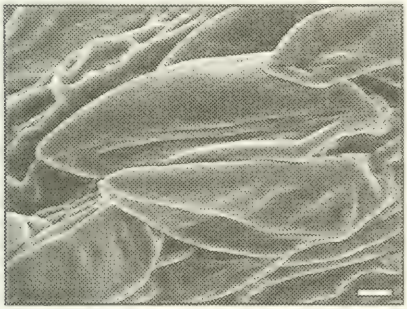


Fig. 7: bar 10μm

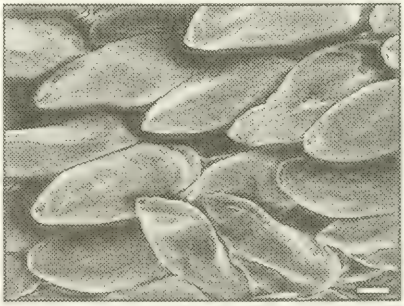


Fig. 8: bar 20μm

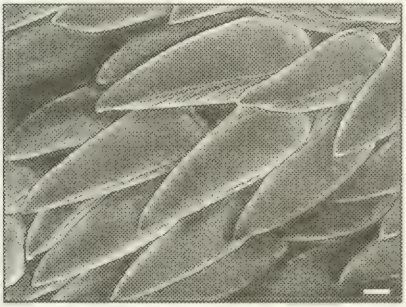


Fig. 9: bar 20μm

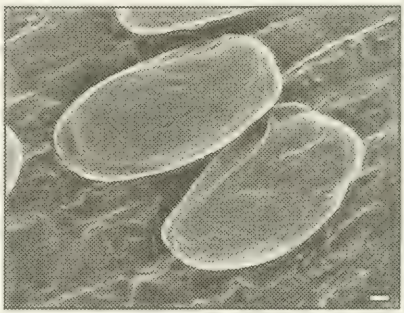


Fig. 10: bar 10μm

Plate 2: 3: *C. moenchioides* Less., *Pirion 492* (GH); 4: *C. ciliata* Ruiz & Pav., *Rosas 1890* (M); 5: *C. microphylla* (Cass.) Hook. & Arn., *Wagenknecht 18489* (GH); 6: *C. chilensis* (Willd.) DC., *Elliott 292* (K); 7: *C. glandulosa* Remy, *Rosas 1592* (M); 8: *C. limbata* (D.Don) Less., *Morrison 16740* (GH); 9: *C. incana* Poepp., *Jiles 5001* (M) ; 10: *C. renifolia* (Remy) Cabrera, *Seibold 2850* (W).

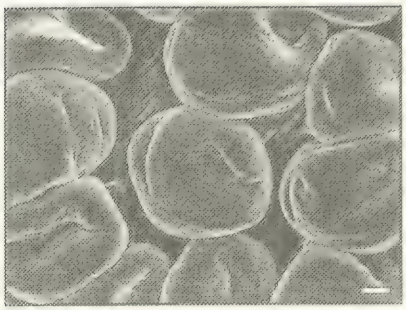


Fig. 11: bar 10μm

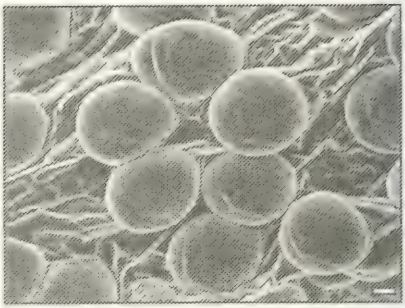


Fig. 12: bar 10μm

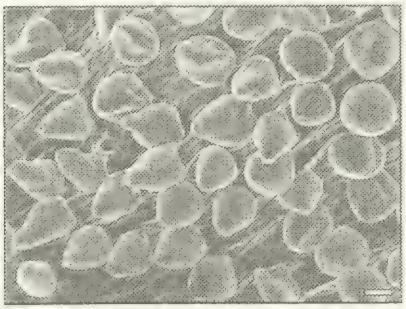


Fig. 13: bar 20μm

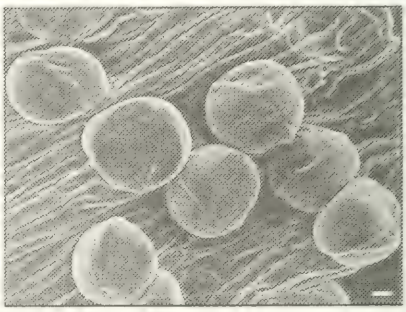


Fig. 14: bar 10μm

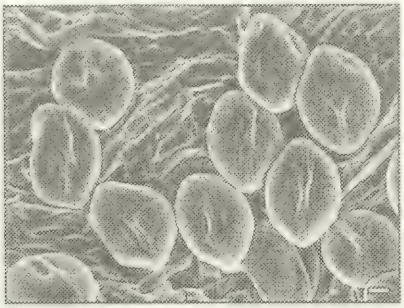


Fig. 15: bar 10μm

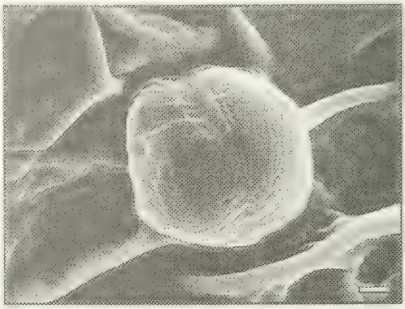


Fig. 16: bar 3μm

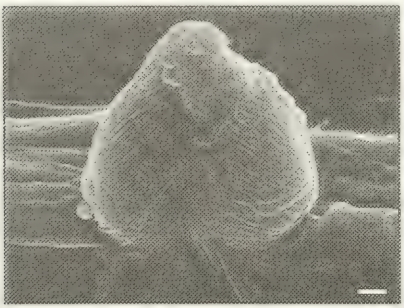


Fig. 17: bar 2μm

Fig. 18: bar 10μm

Plate 3: 11: *C. euphrasioides* (DC.) F.Meigen, *Morrison 17071* (GH); 12: *C. flabellata* D.Don, *Philippi s.n.* (W); 13: *C. flabellata* D.Don, *Grau 2440* (M); 14: *C. lycopodioides* (Remy) Cabrera, *Werdermann 632* (M); 15: *C. pusilla* (D.Don) Hook. & Arn., *Hastings 432* (NY); 16: *C. spathulifolia* Cabrera, *Kiesling, Ulibarri & Krapovikao 7467* (NY); 17: *C. gnaphalioides* (Remy) I.M.Johnst., *Wagenknecht 18590* (GH); 18: *C. minuta* (Phil.) Cabrera, *Castellanos 71644* (W).

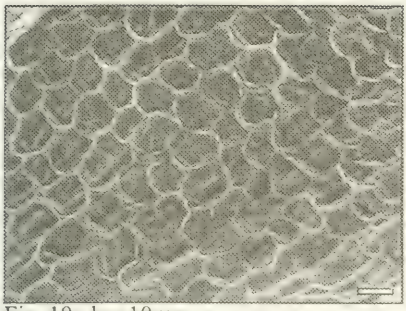


Fig. 19: bar 10 µm

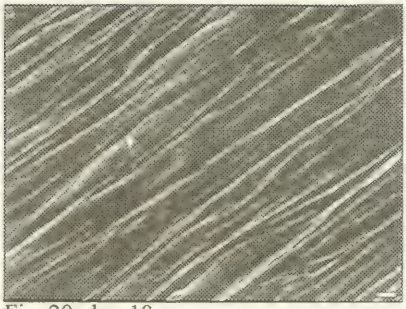


Fig. 20: bar 10 µm

Fig. 21: bar 10 µm

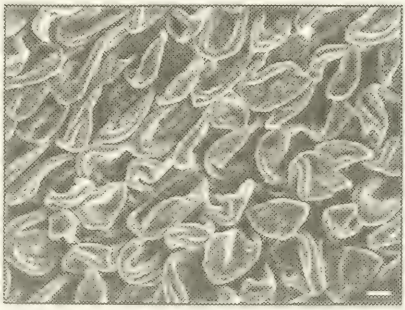


Fig. 22: bar 10 µm

Fig. 23: bar 20 µm

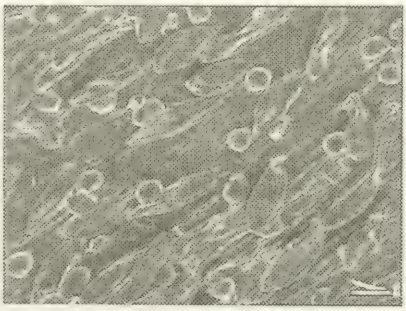


Fig. 24: bar 100 µm

Fig. 25: bar 100 µm

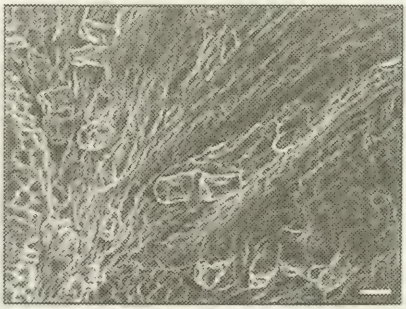


Fig. 26: bar 30 µm

Plate 4: 19: *C sphaeroidalis* (Reiche) Hicken, *Werdermann 253* (K); 20: *C. acerosa* (Remy) Benth. & Hook., *Werdermann 627* (M); 21: *C. pulvinata* (Phil.) Hauman, *Vervoorst 3239* (W); 22: *C. revoluta* (Phil.) Cabrera, *Werdermann 1020* (M); 23: *C. acerosa* (Remy) Benth. & Hook., *Ehrhart & Grau 95/818* (M); 24: *Brachyclados lycioides* D.Don, *Jiles 4870* (M); 25: *Brachyclados megalanthus* Speg., *King & Heinz 9390* (M); 26: *Pachylaena atriplicifolia* Hook. & Arn., *Schajovsky s.n.* (M).

Discussion

1. The taxonomic value of achene hairs above other characters

Historically achene hairs have been rather tentatively used in *Chaetanthera* classifications, even though often used to taxonomic advantage in other Compositae taxa. Now that modern technology has the wherewithal to reveal micro-characters, the true value of these achene variations can be utilised.

Many characters, both qualitative and quantitative were considered. The quantitative characters, such as achene length, did not show useful, discrete discontinuities. Given the large amount of variation they could, however, form a useful contribution to a multivariate analysis of a larger data set. Qualitative characters such as achene shape were found to be unreliable because of fecundity, maturity etc. The achene hairs appeared to be independent of these factors. The shape and size, especially length, was found to be statistically and visually a good discriminator for taxa in this genus. The absence of hairs, or the glabrous state, is not a reliable taxonomic indicator above the species level.

2. Achene hair diversity in the context of subgeneric divisions of *Chaetanthera*

The information regarding achene hair type distribution across the genus is summarised in Table 3. The table shows that clusters of species, traditionally placed in the same subgenera possess similar achene hairs. The patterns of hair type and subgenus fall into one of two categories:

- one hair type groups several subgenera, and
- individual subgenera group several hair types.

This is also illustrated in Plate 5. The hairs are schematically represented (to scale) and accompanied by transverse sections through the hairs, showing hair cell-wall variations, hair width ranges, and hair cell-number.

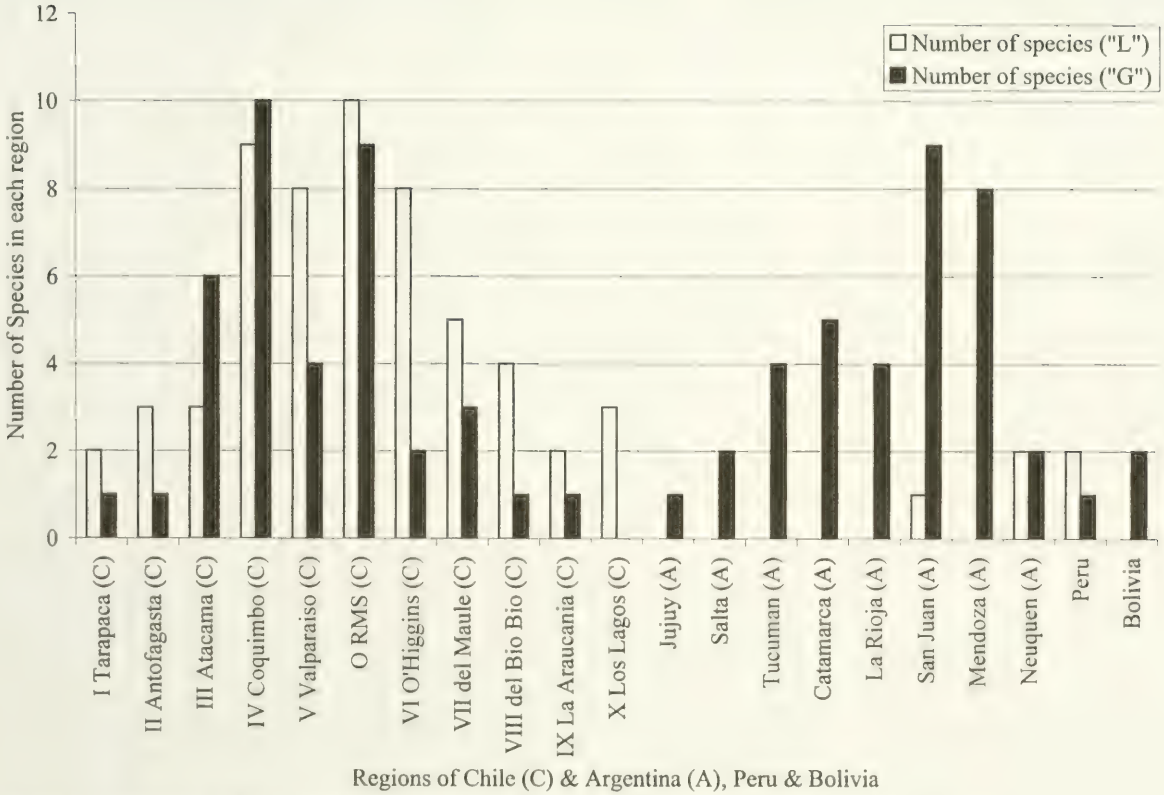
2.1. One hair type – several subgenera.

This grouping represents those species and even subgenera whose achene characters group them together within *Chaetanthera*. The taxa in the subgenera *Proselia, Euchaetanthera, Tylloma*, and *Glandulosa* are virtually inseparable on the basis of their achene features. With only two exceptions (*C. euphrasioides* and *C. flabellata*) the species traditionally placed within these four subgenera share the same type of achene hairs (elliptic or obovate to lanceolate "Zwillingshaare") on both disc and ray achenes and, within a broader sense, have similar sized achenes. There is also little variation in the achene characters among the subgenera themselves. This lack of diversity itself is distinctive. They are quite separate from the remaining taxa in the study.

The taxa in these four subgenera, in particular within *Proselia* and *Euchaetanthera*, are very closely related and often express a wide range of morphological variation. This is reflected in the taxonomy where examples of taxa with several varieties are described (e.g. *C. chilensis*), as well as suites of species that are hard to distinguish from each other (e.g. *C. microphylla* and *C. linearis*).

2.2. One subgenus – several hair types.

The taxa in this grouping pose more of a challenge to interpretation, and in effect represent the taxa that are least well-collected and tricky to sample. Three subgenera fall into this group. The first two, *Egania* and *Oriastrum* show 2–3 hair types, each type found in only 2 or 3 species. The third, *Carmelita*, forms somewhat of an outlier as it, for the most part, exhibits only one hair type. However, there were a couple of oddities that require further investigation.



Graph 6: Distribution of *Chaetanthera* species with Lanceolate ("L") and Glabrous or Globular ("G") achene hairs over South America

2.2.1. Nine species are traditionally grouped into the subgenus *Egania*. United mostly by the possession of interior phyllaries with coloured apical scales and having buds on the lower stem regions, these taxa represent the most under-collected species in the genus, and are consequently the most poorly sampled taxa in this study. Two hair types were revealed: long filamentous hairs and papillae. This was the only subgenus in which some species had consistently glabrous achenes. These hair types are not duplicated elsewhere in the genus *Chaetanthera*.

Five of the species had consistently glabrous surfaces on both disc and ray achenes. This is not a very exciting taxonomic feature, and certainly not a good discriminator considering the propensity of glabrous achenes to appear in amongst otherwise pubescent achene collections. As an aspect of variation this is, however, worth mentioning. The reversal or reduction to the glabrous state is frequent within species of the tribe Mutisieae s.str. (HANSEN, 1991).

C. apiculata and *C. acerosa* were glabrous or had achenes with long filamentous hairs. The distribution of hairy and glabrous achenes in these two species appears to be largely a feature of population variation. A variety of *C. acerosa* (*C. acerosa* var. *dasycarpa* Cabrera) is described as having long seriaceous-villous hairs on the achenes, as opposed to the glabrous achenes of var. *typica*. These two varieties are reputed to co-exist in mixed populations. This is a good example where a detailed population survey could determine whether this is really population variation or a true taxonomic difference. The repeated occurrence of filiform hairs on the fruits of the Compositae is documented. These are considered to be plesiomorphic in the Nassauviinae at least (HANSEN, 1989).

Uniquely in this study, achenes from collections identified as *C. revoluta* and *C. pulvinata* were densely clothed in single-celled deflated papillae. Glabrous achenes were seen in collections of *C. pulvinata*.

2.2.2. The subgenus *Oriastrum* includes 5 species (after CABRERA, 1937). Three sorts of "Zwillingshaare" were identified in this group, and are not found in any other taxa of *Chaetanthera*. *C. pusilla* and *C. planiseta* had nearly identical achenes and hairs. The species are morphologically close, separated from each other by phyllary apex colour, and the pappus bristle form. The small spreading floccose species of *C. minuta* and *C. gnaphalioides* share distinct achene hairs. There is a slightly different third hair shape in the collections that may indicate an hitherto undescribed taxon. Only *C. minuta* has both glabrous and pubescent achenes. *C. lycopodioides* is grouped here with 2 taxa normally included in *Euchaetanthera* – *C. flabellata*, and *C. euphrasioides*. All three species share achene hairs on both disc and ray achenes that are strictly spherical to softly conical (on same achene). The achene is also often a distinct pyriform shape. Currently there is little else to support the grouping of these three taxa.

2.2.3. The three taxa in the subgenus *Carmelita* are generally very distinct, on account of the individual nature of the leaves and phyllary morphology. *C. lanata* and *C. spathulifolia* have very similar but sparse hairs, all occurring in some state of deterioration. *C. lanata* however also had examples of completely glabrous achenes, like those of *C. villosa*, and, very rarely, large hairs, as seen in the taxa belonging to *Tylloma*. These collections of *C. lanata* are currently under more intensive review. They have not been illustrated in Plate 5 because of the puzzling nature of the result.

From this brief discussion regarding the distribution of the achene hairs across the genus *Chaetanthera* the taxonomic significance of the achene hairs can be seen to vary in different subgenera. The variation in these achene characters raises the question "Is the rank of subgenus the correct rank for the separation of these groups of species?" The informative potential of the geographical distribution of the hair types is considered next.

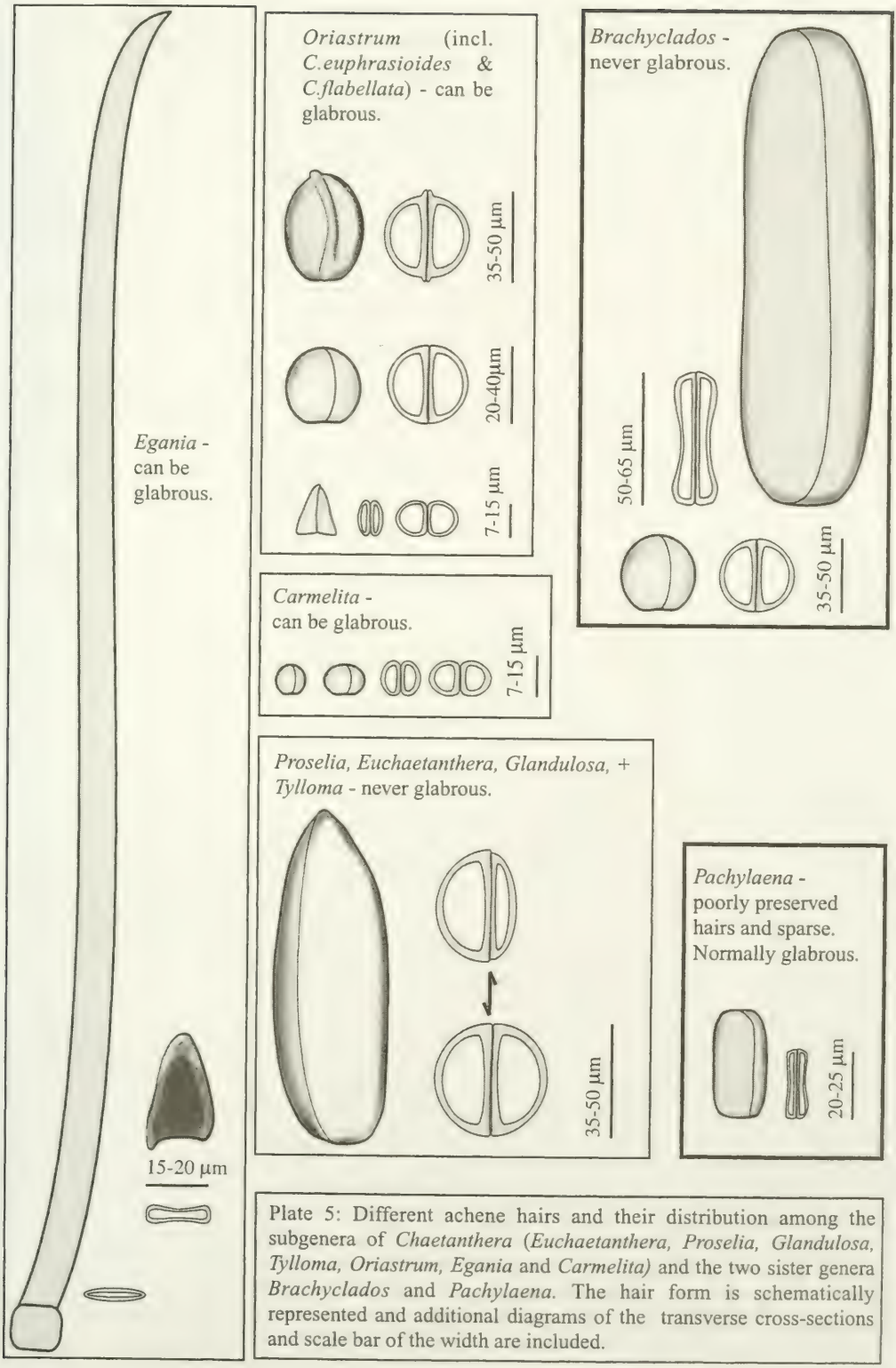


Plate 5: Different achene hairs and their distribution among the subgenera of *Chaetanthera* (*Euchaetanthera, Proselia, Glandulosa, Tylloma, Oriastrum, Egania* and *Carmelita)* and the two sister genera *Brachyclados* and *Pachylaena*. The hair form is schematically represented and additional diagrams of the transverse cross-sections and scale bar of the width are included.

3. Achene hairs and their geographical distribution

The species in *Chaetanthera* can be arbitrarily divided into two large groups based on their achene hair type. The species numbers in both groups also include those described taxa interpreted as belonging to the group from a morphological point of view, although no achenes were seen. The distribution of each taxon was collected using primarily the herbarium collection information, but supplemented by literature citations too.

The first group comprises all 22 species, in the subgenera *Proselia, Euchaetanthera, Tylloma*, and *Glandulosa,* possessing the obovate-lanceolate hair type on both achenes. It is identified by the epithet "L" (this is effectively Table 3, section 3.1.1.). The second group "G" contains 21 species mostly from subgenera *Carmelita*, *Egania* and *Oriastrum* (Table 3, sections 3.1.2., 3.1.3., 3.2., 3.3., and 3.4.). It includes all taxa described as being glabrous or having globular (or filiform or papillose) hairs. A histogram showing the geographical distribution over South America of numbers of species in each group ("L") and ("G") is plotted in Graph 6.).

This shows us the hotspots of species diversity in each group; "L" is centred in Chilean Región Metropolitana de Santiago (RMS), and "G" is centred over the high Andean border between RMS (Chile), and the neighbouring regions of San Juan and Mendoza in Argentina. Furthermore, the "L" group is confined (with the exception of 2 records in San Juan and Neuquen, Argentina) to the west of the Andean mountain range with 2 species exclusive to Peru. The "G" group is confined to the Andes, but spread both to the east and west of the main mountain chain, with over 70% of the species in this group found in both Chile and Argentina. Thus we see two different patterns of distribution for the two artificial species groupings based solely on achene hair type.

If we consider the altitude information as well, as a general rule the "L" species are distributed at altitudes ranging from sea level to just over 2000 m. The "G" species are usually to be found above this altitude (2000 m) up to 5000 m.

The summary of distribution, altitude and geography is in Table 4.

Table 4: Summary of information supporting the 2 groups of achene hairs.

Source	"L" (= *Proselia, Euchaetanthera, Tylloma, Glandulosa)*	"G" (= *Egania, Oriastrum* and *Carmelita*)
Distribution	Chile & Peru. Concentrated in RMS (Chile).	Chile, Argentina, Bolivia & Peru. Concentrated over RMS (Chile) & San Juan & Mendoza (Argentina).
Geography & Altitude	Coastal lowlands & mountains; lower Andean regions. Mostly 0–2000 m.	High Andean regions. Mostly 2000–5000 m.

It seems that several sources of information (achene characters, and distribution) point towards a split within the genus *Chaetanthera* that is not really reflected by the assignment of the rank "subgenus". Nevertheless it is well recognised that a single character – here strongly weighted towards achene hairs – is not sufficient to bind or separate ranks in a taxonomic hierarchy. Correlating suites of morphological characters drawn from other sources should support the achene characters. Further correlating character progressions are currently under investigation. These include parallel progressions seen in the two groups in capitulum size and floret ratios, life cycles, and habit, among others.

4. Achene hair diversity between the genera

The significance of the results from *Pachylaena* and *Brachyclados* cannot be extensively interpreted. *Pachylaena* achenes show preliminary similarities to the achenes and hairs seen on species included in the *Chaetanthera* subgenus *Tylloma,* but much smaller. The two *Brachyclados* species both had "Zwillingshaare" (Table 3, section 3.1.5.) of a similar nature

to the obovate-lanceolate achene hairs but distinctly longer. However, *B. lycioides* also had a second hair type – the spherical "Zwillingshaare" (Table 3, section 3.1.2.b). The presence of two hair types on the same achenes, which in *Chaetanthera* are so clearly segregated, is interesting.

The achene hair information from these two genera *Pachylaena* and *Brachyclados* indicates that they are indeed outliers to *Chaetanthera*, and do not form part of this carpologically diverse genus as it stands.

KARIS et al. (1992) sampled collections of six *Chaetanthera* species in their phylogenetic analysis of the Cichorioideae. They found that *Chaetanthera* formed part of a monophyletic cluster with, among others, *Gerbera*, *Mutisia* and *Trichocline*. Unfortunately they did not consider *Pachylaena* or *Brachyclados*. BREMER (1994) postulated that *Pachylaena* could have its sister group within a paraphyletic *Chaetanthera*. Were *Chaetanthera* to be monophyletic, then this could be resolved with a cladistic analysis of *Chaetanthera* and *Pachylaena* with *Brachyclados* as an outgroup.

Other studies (GRAU, 1980; BREMER, 1994), conducted at the generic level, cite *Chaetanthera* results that are often based on material pertaining only to taxa belonging to the "L" group. In the light of the achene hair results, these studies have limited usefulness for a discussion of generic limits of *Chaetanthera*.

Conclusion

Many studies indicate that where divergent achene hair types are found, they are frequently indicative of natural generic boundaries. The question then remains: do the divergent achene hairs types found in this study represent a fundamental split in the "genus" *Chaetanthera* different to that hitherto reflected in the current classification?

Several points can be highlighted:

- There is more variation among the achenes of the genus *Chaetanthera*, in particular regarding the achene hairs, than hitherto described. The variation in the achene hairs shows a dramatic division of the species found in the genus *Chaetanthera* Ruiz & Pav.
- Although achene hair length is closely correlated to shape, achene hair type was found to be a clear descriptor of species clusters above the specific level, at the subgeneric level. The absence of achene hairs (the glabrous state) is not, as a rule, a taxonomically useful feature at the sub-generic level.
- 4 subgenera *Proselia, Euchaetanthera, Tylloma*, and *Glandulosa* form one group with the same achene hair type (obovate-lanceolate "Zwillingshaare"). 3 subgenera, *Oriastrum, Egania* and *Carmelita*, express 6 different achene hair types and include the majority of glabrous achenes. Geographical distribution data and altitude information show correlating trends with species groupings based on achene hair characters.
- The two genera *Brachyclados* and *Pachylaena* were shown to be distinct from all groupings within the genus *Chaetanthera* based on achene hairs.

This study implies that achene diversity could be representative of significant divisions within the genus *Chaetanthera* as it stands. In particular the separation of the subgenera *Proselia, Euchaetanthera, Tylloma*, and *Glandulosa* (as one group) from *Oriastrum, Egania* and *Carmelita* seems a possibility. The achene characters of the outlying genera *Pachylaena* and *Brachyclados* while interesting, do not help clarify these divisions. The variation we have found has highlighted those areas of the genus which urgently need reviewing. The search for more characters to resolve the question of the generic limits of *Chaetanthera* continues and a full revision is currently in progress.

Grateful thanks are extended to Prof. J. Grau, the Curators and Directors of the herbaria who generously loaned the material used in this research and to Dr R. Davies.

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Alison M.R. DAVIES, Institut für Systematische Botanik der Ludwig-Maximilians-Universität München, Menzinger Straße 67, D-80638 München, Germany.

Appendix

The collections cited here represent specimens (limited to a maximum of two) that had typical achene hairs for the species. The collections that contributed to the wider understanding of this project are not cited. The collections in bold are photographically illustrated in this paper.

Taxonomic Name	Typical Collections Surveyed
C. acerosa (Remy) Benth. & Hook.	*Buchtien 84* (M); *Johnston 5925* (GH)
C. apiculata (Remy) F. Meigen	***Ehrhart & Grau 95/818* (M)**; ***Werdermann 627* (M)**
C. chilensis (Willd.) DC.	***Elliott 292* (K)**; *Grau 2495* (JG)
C. ciliata Ruiz & Pav.	*Grau 2400* (M); ***Rosas 1890* (M)**
C. cochlearifolia (A. Gray) B. L. Rob.	*MacBride & Featherstone 845* (GH)
C. dioica (Remy) B. L. Rob.	*Sleumer 1875* (W)
C. elegans Phil.	*Rosas 1875* (M); *Werdermann 1256* (M)
C. euphrasioides (DC.) F. Meigen	***Morrison 17071* (GH)**; *Philippi s.n.* (W)
C. flabellata D. Don	***Grau 2440* (M)**; ***Philippi s.n.* (W)**
C. glabrata (DC.) F. Meigen	*Rosas 1076* (M); *K. & W. Rechinger 63504* (M)
C. glandulosa Remy	***Rosas 1592* (M)**; *Morrison & Wagenknecht 17104* (K)
C. gnaphalioides (Remy) I. M. Johnst.	*Jiles 4158* (M); ***Wagenknecht 18590* (GH)**
C. incana Poepp.	***Jiles 5001* (M)**; *K. & W. Rechinger 63743* (W)
C. lanata (Phil.) I. M. Johnst.	*Werdermann 934* (M); *Jiles 2487* (M)
C. limbata (D. Don) Less.	*Rosas 1226* (M); ***Morrison 16740* (GH)**
C. linearis Poepp.	*K. & W. Rechinger 63321* (M); *Werderman 890* (M)
C. lycopodioides (Remy) Cabrera	*Morrison 17300* (K); ***Werdermann 632* (M).**
C. microphylla (Cass.) Hook. & Arn.	*Grau 2542* (M); ***Wagenknecht 18489* (GH)**
C. minuta (Phil.) Cabrera	***Castellanos 71644* (W)**; *Johnston 6094* (GH)
C. moenchioides Less.	*Grau 2360* (JG); ***Pirion 492* (GH)**
C. pentacaenoides (Phil.) Hauman	*Sparre 1572* (K)
C. peruviana A. Gray	*Weberbauer 6876* (GH)
C. planiseta Cabrera	*Germain #1246* (W); ***Hastings 432* (NY)**
C. pulvinata (Phil.) Hauman	*Sleumer 374* (W); ***Vervoorst 3239* (W)**
C. pusilla (D. Don) Hook. & Arn.	*Grau 3293* (M); *Seibold 2990* (W)
C. renifolia (Remy) Cabrera	*C. Grandjot s.n.* (M); ***Seibold 2850* (W)**
C. revoluta (Phil.) Cabrera	***Werdermann 1020* (M)**
C. serrata Ruiz & Pav.	*Grau s.n.* (M); *Pennell 12836* (GH)
C. spathulifolia Cabrera	***Kiesling, Ulibarri & Krapovickao 7467* (K)**; *Malme 2940* (GH)
C. sphaeroidalis (Reiche) Hicken	*Castellanos 71647* (W); ***Werdermann 253* (M)**
C. splendens (Remy) B. L. Rob.	*Jiles 4816* (M)
C. stuebelii Hieron.	*Venturi 9266* (GH)
C. tenella Less.	*Grau 2407* (M); *Werdermann 815* (GH)
C. valdiviana Phil.	*Philippi 359a* (P)
C. villosa D. Don	*Hollermayer 415* (W); *Schajovskoy s.n.* (M)
Brachyclados lycioides Hook. & Arn.	***Jiles 4870* (M)**; *Schajovskoy 150* (M).
Brachyclados megalanthus Speg.	***King & Heinz 9390* (M)**
Pachylaena atriplicifolia Hook. & Arn.	*Schajovskoy 321* (M); ***Schajovskoy s.n.* (M)**

Polytrichadelphus magellanicus sensu lato (Musci) and its ascomycetes – different fungi on different hosts

P. DÖBBELER

Abstract:
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Forty-six herbarium specimens of the moss *Polytrichadelphus magellanicus* s.l. (Polytrichaceae) from all parts of its (sub)antarctic distribution area were analysed for associated fungi. On thirty-eight specimens fruit-bodies representing ten species of ascomycetes were found. *P. magellanicus* s.str. from Patagonia and Tierra del Fuego was found to be an excellent host, infected by nine fungal species belonging to seven genera. Each of the fifteen infected collections was associated, on average, with four different fungal species. However, on the twenty-three infected specimens of *P. innovans* from New Zealand, the Auckland Islands, Australia and Tasmania, only *Epibryon pogonati-urnigeri* was present with regularity. Except for the unspecific *Bryochiton perpusillus* both host mosses have their own parasites. This underlines the distinctness of *P. magellanicus* s.str. from southern South America and *P. innovans* from Australasia. These taxa have probably developed independently from each other over a long time period. Relations between *P. innovans* and *Pogonatum urnigerum* are discussed.

Zusammenfassung:
Sechsundvierzig Herbarbelege des Laubmooses *Polytrichadelphus magellanicus* s.l. (Polytrichaceae) aus allen Teilen des (sub)antarktischen Verbreitungsgebietes wurden auf Pilzbefall hin analysiert. Auf achtunddreißig Proben konnten Fruchtkörper nachgewiesen werden, die zehn Arten von Ascomyceten repräsentieren. *P. magellanicus* s.str. aus Patagonien und Feuerland ist mit neun vorkommenden Pilzarten, die zu sieben Gattungen gehören, ein ausgezeichneter Wirt. Jede der fünfzehn befallenen Aufsammlungen weist im Durchschnitt vier verschiedene Pilzarten auf. Auf den dreiundzwanzig Proben von *P. innovans* aus Neuseeland, den Auckland Inseln, Australien und Tasmanien ist hingegen fast nur *Epibryon pogonati-urnigeri* vorhanden, allerdings mit erstaunlicher Regelmäßigkeit. Abgesehen von dem unspezifischen *Bryochiton perpusillus* haben beide Wirtsmoose ihre eigenen Parasiten. Das unterstreicht die Eigenständigkeit von *P. magellanicus* s.str. aus dem südlichen Südamerika und *P. innovans* aus Australasien. Vermutlich haben sich beide Sippen über lange Zeiträume getrennt voneinander entwickelt. Diskutiert werden Beziehungen zwischen *P. innovans* und *Pogonatum urnigerum*.

Introduction

Two randomly collected specimens of *Polytrichadelphus magellanicus* (Hedw.) Mitt. (Polytrichales, Musci) from Tierra del Fuego proved to be extremely good hosts for parasitic asco-

mycetes. Six and seven species, respectively, were recorded, representing no less than five genera and four orders. Apparently, hundreds of ascomata may be formed on a single host plant without causing any symptoms visible to the naked eye (DÖBBELER 1999b). The present study analyses the fungal diversity within different populations of *P. magellanicus* in southern South America and *P. innovans* (Müll.Hal.) A.Jaeger in Australasia. The latter taxon often was not separated from *P. magellanicus* (e.g. BEEVER et al. 1992, FIFE 1995, RAMSAY 1997, SCOTT & STONE 1976, van ZANTEN 1978: 460).

Material and methods

Specimens of *Polytrichadelphus magellanicus* s.l. from the bryological herbaria B, F, G, GZU, JE, M and W were screened for the presence of fungi. Before studying the plants it was necessary to wet them thoroughly. This clearly demonstrates their endohydric organization as well as highlighting the water repellent lamellae margins. Small or sparsely distributed ascomata were only detectable by microscopic screening of individual host leaves. Lugol's solution (Merck 9261) was used to test iodine reactions. Infected plants, or parts of them, were separated and deposited under the fungal name in the corresponding host herbarium.

Specimens examined

Polytrichadelphus magellanicus s.str. as host (specimens 12 and 13, reported by DÖBBELER 1996, are included)

1 Chile. Prov. de Cautín, Volcano Villarrica, ca. 1000 m, *Hollermayer 56* (W). Recorded species: *Crocicreas magellanicum, Dawsophila polycarpa, Potriphila neurogena, Rogellia nectrioidea.*

2 Chile. Prov. de Cautín, Andes of Villarrica, (probably 1897), *Neger* (JE). Recorded species: *Crocicreas magellanicum, Dawsophila polycarpa, Potriphila navicularis, P. neurogena.*

3 Chile. Prov. de Valdivia, Corral, near Quitaluto, ca. 400 m, 2.2.1935, *Hosseus 698* (JE). Recorded species: *Bryochiton perpusillus, Crocicreas magellanicum.*

4 Chile. Prov. de Valdivia, Cordillera Pelada, road from La Unión to El Mirador, 800 m, 12.12. 1985, *Hellwig 8560* (M). Recorded species: *Dawsophila polycarpa, Rogellia nectrioidea.*

5 Chile. Prov. de Valdivia, West slope of Cordillera Pelada, 8.8 km by road W of El Mirador on road between La Unión and Punta Hueicolla, 580 m, 40°07'S, 73°16'W, 18.2.1976, *Crosby 12758* (B, W). Recorded species: *Crocicreas magellanicum, Dawsophila polycarpa.*

6 Chile. Prov. de Chiloé, Trumao, path to "Madrina", 200 m, 28.5.1932, *Junge 424* (F). Recorded species: *Bryochtion perpusillus, Crocicreas magellanicum, Dawsophila polycarpa.*

7 Chile. "Waldhagen", [*Nothofagus*] *pumilio*-tree line, 1200 m, 1.1.1938, *Schwabe 34* (JE). Recorded species: *Dawsophila polycarpa, Epibryon eremita, Potridiscus polymorphus, Potriphila navicularis, P. neurogena, Rogellia nectrioidea.*

8 Chile. Prov. de Coihaique, Checkpoint Cisnes Medio of the Carretera Austral, IV.1985, *Hellwig 811* (M). Recorded species: *Bryochiton perpusillus, Crocicreas magellanicum, Dawsophila polycarpa.*

9 Chile. Prov. de Magallanes, Punta Arenas, 1917, *Hicken* (B). Recorded species: *Crocicreas magellanicum, Dawsophila polycarpa, Potriphila navicularis, P. neurogena.*

10 Chile. Prov. de Antártica Chilena, Canal Beagle, II.1922, *Gusinde 339* (W). Recorded species: *Crocicreas magellanicum, Dawsophila polycarpa, Potriphila navicularis, P. neurogena, Rogellia nectrioidea.*

11 Argentina. Tierra del Fuego, Dep. Ushuaia, Río Olivia, 27.9.1979, *Matteri NC2153* (B). Recorded species: *Bryochiton perpusillus, Crocicreas magellanicum, Dawsophila polycarpa.*

12 Argentina. Tierra del Fuego, Dep. Ushuaia, about 30 km E of Ushuaia, road from Ushuaia to Paso Garibaldi, ca. 190 m, 22.3.1997, *Mues* (M). Recorded species: *Crocicreas magellanicum, Dawsophila polycarpa, Epibryon eremita, E. interlamellare, Potriphila navicularis, P. neurogena* (Type).

13 Argentina. Tierra del Fuego, Dep. Ushuaia, near Paso Garibaldi, ca. 430 m, 20.3.1997, *Mues* (M). Recorded species: *Crocicreas magellanicum* (Type), *Dawsophila polycarpa* (Type), *Epibryon eremita* (Type), *E. interlamellare*, *Potriphila navicularis*, *P. neurogena*, *Rogellia nectrioidea* (Type).
14 Argentina. Tierra del Fuego australis, Dep. Ushuaia, Montes Martiales, 320 m, 54°46'S, 68°18'W, 30.12.1969, *Roivainen* (Plantae Argentinae 1480, sub *Polytrichadelphus magellanicus*), (G). Recorded species: *Dawsophila polycarpa*.
15 Argentina. Tierra del Fuego, Dep. Ushuaia, Cerro Martial, 350 m, 5.1.1989, *Schäfer-Verwimp & Verwimp 10849* (G). Recorded species: *Crocicreas magellanicum*, *Dawsophila polycarpa*, *Epibryon eremita*, *E. interlamellare*, *Potriphila navicularis*, *P. neurogena*.

Polytrichadelphus innovans as host

16 New Zealand. (without further notes), com. Dr. Schwarz (W). Recorded species: *Epibryon pogonati-urnigeri*.
17 New Zealand. North Island, North Auckland, Waipoua forest, 50 km NW of Dargaville, ca. 300 m, 9.1.1974, *van Zanten 7401214* (B). Recorded species: *Epibryon pogonati-urnigeri*.
18 New Zealand. North Island, Paradise Valley, Fish hatchery, near Rotorua, 7.1.1969, *O. & I. Degener 31830* (GZU). Recorded species: *Epibryon pogonati-urnigeri*.
19 New Zealand. North Island, Waiotapu, IX.1929, *Meebold* (M). Recorded species: *Epibryon pogonati-urnigeri*.
20 New Zealand. North Island, Bay of Plenty, Kaingaroa plantation forest, SE of Rotorua, ca. 600 m, 25.10.1959, *van Zanten 1251* (B). Recorded species: *Epibryon pogonati-urnigeri*.
21 New Zealand. North Island, Tauhara, Taupohill, about 2500', IX.1929, *Meebold* (M). Recorded species: *Epibryon pogonati-urnigeri*.
22 New Zealand. North Island, Waitakerei Range, 1206', IX.1929, *Meebold* (M). Recorded species: *Bryochiton perpusillus*.
23 New Zealand. North Island, Gisborn district, Lake Waikaremoana, along road from Waiotukupuna-bridge to Cascade Falls, ca. 600 m, 29.8.1968, *van Zanten 681886* (JE). Recorded species: *Epibryon pogonati-urnigeri*.
24 New Zealand. North Island, Mt. Egmont, 3000', VIII.1929, *Meebold* (M). Recorded species: *Epibryon pogonati-urnigeri*.
25 New Zealand. North Island, Mt. Egmont, Dawson Falls, 6.3.1959, *H. & E. Walter* (M). Recorded species: *Epibryon pogonati-urnigeri*.
26 New Zealand. North Island, Hawke's Bay, near Whakarara, Gardiner's Mill, 31.12.1950, *Sainsbury* (W). Recorded species: *Epibryon pogonati-urnigeri*.
27 New Zealand. North Island, Wellington, York Bay, V.1929, *Meebold* (M). Recorded species: *Epibryon pogonati-urnigeri*.
28 New Zealand. South Island, Westland, Teramakau Valley, 600 ft, 6.2.1903, *Naylor Beckett* (JE). Recorded species: *Epibryon pogonati-urnigeri*.
29 New Zealand. South Island, West Coast Area, N of Whataroa, 7.2.1970, *Vitt 4505* (B). Recorded species: *Bryochiton perpusillus*, *Epibryon pogonati-urnigeri*.
30 New Zealand. South Island, South Otago, The Chaslands, along highway 93, 14.1.1973, *Visch* (B). Recorded species: *Epibryon pogonati-urnigeri*.
31 New Zealand. Stewart Island, I.1889, *Bell* (M). Recorded species: *Epibryon pogonati-urnigeri*.
32 Auckland Islands. Auckland Island, South end of North Harbour, 12.1.1973, *Vitt 10223* (M). Recorded species: *Epibryon pogonati-urnigeri*.
33 Australia. Victoria, Baw Baw National Park, 6 km SE of Mt. Erica, road cutting on Mt. Erica, 700–800 m, 37°35'S, 146°23'E, 10.1.1986, *Rambold 3276* (M). Recorded species: *Epibryon pogonati-urnigeri*.
34 Australia. Victoria, Baw Baw National Park, 6 km SE of Mt. Erica, road cutting on Mt. Erica, 900–1000 m, 37°35'S, 146°23'E, 10.1.1986, *Rambold 3280* (M). Recorded species: *Epibryon pogonati-urnigeri*.
35 Australia. Victoria, Mt. Donna Bvang, 5 km N of Warburton, 1200 m, 12.4.1974, *Streimann 991* (B). Recorded species: *Epibryon pogonati-urnigeri*.
36 Tasmania. (without further notes), *Lucas* (M). Recorded species: *Epibryon pogonati-urnigeri*.
37 Tasmania. NW of Mt. Field, Florentine Valley, 21.1.1959, *H. & E. Walter* (M). Recorded species: *Epibryon pogonati-urnigeri*.
38 Tasmania. Hobart, Mt. Wellington, 14.4.1903, *Fleischer B2074* (B). Recorded species: *Epibryon pogonati-urnigeri*.

The ascomycetes recorded

Bryochiton perpusillus Döbbeler (DÖBBELER, Mitt. Bot. Staatssamml. München 14: 226, 1978)
Hosts: *Polytrichadelphus magellanicus, P. innovans* (and other bryophytes, see below)
Distribution on *Polytrichadelphus*: Chile, Argentina, New Zealand
Specimens examined: 3, 6, 8, 11, 22, 29

Bryochiton perpusillus is a very widespread and variable species recorded from distantly related bryophytes, often with a withered appearance, indicating that taxonomic uniformity should be proved. Partially damaged hepatics, like *Ptilidium* occur within the spectrum of hosts besides the Polytrichaceae, including *Dawsonia* (DÖBBELER 1978, 1981). *B. perpusillus* most regularly colonises *Polytrichum piliferum* Hedw. where it develops subcuticularly from a conspicuous network of thick brown hyphae, especially in the apical, abaxial region of normal looking or hardly altered leaves. On *Polytrichadelphus, Bryochiton perpusillus* occurs in lower concentrations. Ascomata are sparse on the lower, withering leaves of a plant, suggesting the saprophytic tendency of the fungus. Generally, apical regions of individual leaves are preferred and often both sides of a leaf have fruit-bodies as well as the interlamellar spaces being infected. Here the ascomata may look very similar to those of *Epibryon pogonati-urnigeri*. However, the latter species prefers upper healthy leaves where the fungus is completely surrounded by the leaf lamellae. A positive iodine reaction within the ostiolar region immediately reveals *E. pogonati-urnigeri*.

Crocicreas magellanicum Döbbeler (DÖBBELER, Haussknechtia Beih. 9: 81, 1999b)
Host: *Polytrichadelphus magellanicus*
Distribution: Chile, Argentina
Specimens examined: 1–3, 5, 6, 8–13, 15

Due to a lack of contrast with its substrate, the white to nearly hyaline apothecia of *Crocicreas magellanicum* are often difficult to detect, especially when hidden between the leaf lamellae and sparse in numbers. Microscopically screened leaves repeatedly proved to be infected, though apothecia could not be seen by low stereo-microscopic magnification.

Dawsophila polycarpa Döbbeler (DÖBBELER, Haussknechtia Beih. 9: 83, 1999b)
Host: *Polytrichadelphus magellanicus*
Distribution: Chile, Argentina
Specimens examined: 1, 2, 4–15

The two species *Dawsophila callichroma* Döbbeler and *D. pygmaea* Döbbeler frequently colonise different members of the genus *Dawsonia* and are present within its whole Australasian distribution range (DÖBBELER 1981). Though special attention was paid to seeking *Dawsophila* on *Polytrichadelphus innovans*, which shares its distribution for the most part with *Dawsonia*, ascomata could not be detected.

Epibryon eremita Döbbeler (DÖBBELER, Haussknechtia Beih. 9: 85, 1999b)
Host: *Polytrichadelphus magellanicus*
Distribution: Chile, Argentina
Specimens examined: 7, 12, 13, 15

Several ascomata of collection 15 had approximately thirty-two spores per ascus unlike the eight spores per ascus found in the other three specimens, including the type specimen. Spore size among specimens was similar. The larger asci (up to 60 μm long) found in the 32-spored asci

simply accommodate a larger spore number than the smaller asci (35–40 µm long). As there are no other differences to the type material, spore number and ascus size do not seem to be of taxonomic significance. Relations to *Epibryon elegantissimum* Döbbeler on *Dawsonia superba* Grev. in New Zealand (DÖBBELER 1981) may exist, judging by fruit-body morphology, hymenial features and the peculiar microhabitat preference.

Epibryon interlamellare (Racov.) Döbbeler (DÖBBELER, Mitt. Bot. Staatssamml. München 14: 279, 1978)
Hosts: *Polytrichadelphus magellanicus* (and other Polytrichaceae)
Distribution on *Polytrichadelphus*: Argentina
Specimens examined: 12, 13, 15

This frequent and widespread species infects different Polytrichaceae (see DÖBBELER 1999b).

Epibryon pogonati-urnigeri Döbbeler (DÖBBELER, Mitt. Bot. Staatssamml. München 14: 296, 1978)
Hosts: *Polytrichadelphus innovans* (and other Polytrichaceae, see below)
Distribution on *Polytrichadelphus*: New Zealand, Auckland Islands, Australia, Tasmania
Specimens examined: 16–21, 23–38

The young, upper leaves of an infected plant normally contain only a few ascomata which are restricted to the apical leaf region. Due to a lack of space, they are very laterally compressed. Often the ascomatal walls adjacent to the lamellae are reduced or completely missing. In older leaves ascomata are more evenly distributed and spherical. Heavily infected, 6 mm long leaves of different collections commonly yielded about hundred ascomata. In one case an individual leaf of 8 mm length was colonised by approximately 180 ascomata. The species is quite uniform on *Polytrichadelphus innovans*, although slight differences in spore size and other features between collections on different Polytrichaceae or from different geographical regions apparently exist. An essential feature of *Epibryon pogonati-urnigeri* is its iodine reaction, which is not known in other bryophilous ascomycetes. The ostiolar region turns reddish in Lugol's solution and KOH pretreatment gives a more distinct bluish colour (hemiamyloid reaction, BARAL 1987).

Four polytrichaceous hosts are known for *Epibryon pogonati-urnigeri* in addition to *Polytrichadelphus innovans*, namely *Pogonatum urnigerum* (Hedw.) P.Beauv., *P. dentatum* (Brid.) Brid. (DÖBBELER 1978, 1985), *Dawsonia longiseta* Hampe and *D. polytrichoides* R.Br. (DÖBBELER 1981). With the exception of *P. dentatum*, for which only a few data are available, these mosses are very regularly or (in certain regions) even indiscriminately infected by *E. pogonati-urnigeri*. Both species of *Pogonatum* represent the subgenus *Dendroidea* (HYVÖNEN 1989). It is rather well documented that *E. pogonati-urnigeri* occupies wide areas of the geographical range of *P. urnigerum* (DÖBBELER 1978, 1985) which is distributed in northern Eurasia, North America and in scattered high mountain localities in Africa, southeast Asia and Papua New Guinea (HYVÖNEN 1989). After studying hundreds of European Polytrichaceae it is obvious that species like *Pogonatum aloides* (Hedw.) P.Beauv. (*P.* subgen. *Pogonatum*) or *Polytrichastrum alpinum* (Hedw.) G.L.Sm. (syn. *Pogonatum alpinum* (Hedw.) Röhl.) do not host *E. pogonati-urnigeri*. *Dawsonia longiseta* and *D. polytrichoides* make up the more primitive section of the genus *Dawsonia* (*D.* sect. *Dawsonia*) and are restricted to eastern Australia (van ZANTEN 1973). On studying representative material DÖBBELER (1981) observed that ascomata of *Epibryon pogonati-urnigeri* were always present on both *D. longiseta* and *D. polytrichoides* whereas for *D. superba* (*D.* sect. *Superba*) the situation is quite different. Though occurring within the range of the parasite in New Zealand, Australia and Tasmania, parasitism by

E. pogonati-urnigeri occurred only exceptionally. The mosses in question are not ecologically separate as they (as most Polytrichaceae) prefer open, exposed soil as on river banks and road cuttings.

How should one interpret the range of hosts for *Epibryon pogonati-urnigeri*? It exhibits specificity between sections within *Dawsonia* and *Pogonatum* and between *Pogonatum urnigerum* and *Polytrichastrum alpinum*, but it does not discriminate among genera as different as *Pogonatum, Polytrichadelphus* and *Dawsonia*. The differences between these genera may not be as great as one might initially suppose because they are distinguished by sporophytic characters, i.e. capsule morphology. The gametophytic plants are well-developed and share several common features. The leaves are characterised by a distinct sheath and swelling tissue. They bear densely formed adaxial lamellae with specialised marginal cells which are covered in *Polytrichadelphus* and *Dawsonia* with angular flakes of epicuticular wax. In this respect they differ from other Polytrichaceae (PROCTOR 1992). Though species of *Pogonatum* vary greatly regarding waxy deposits, *P. urnigerum* appears "to be highly distinctive, with epicuticular wax on the papillose lamella margins in the form of flakes or platelets not unlike those of *Dawsonia* and *Polytrichadelphus*" (CLAYTON-GREENE et al. 1985: 552; see also PROCTOR 1979). On a macroscopic level, the upper leaf surface of these mosses displays a glaucous bloom caused by the waxy coverings. Another leaf character common to *Pogonatum urnigerum* and *Polytrichadelphus innovans* are similar lamellae hairs (DÖBBELER 1999a, Figs. 4, 5). Nevertheless, recent molecular results on the phylogeny of the Polytrichales by HYVÖNEN et al. (1998) do not support a very close relationship between the genera in question.

Potridiscus polymorphus Döbbeler & Triebel (DÖBBELER & TRIEBEL, Hoppea 61: 72, 2001)
Hosts: *Polytrichadelphus magellanicus* (and other Polytrichaceae, especially *Polytrichum juniperinum* Hedw., DÖBBELER & TRIEBEL 2001)
Distribution on *Polytrichadelphus*: Chile
Specimen examined: 7

This distinctive species with a palaeoaustral distribution is more frequent than previously thought. *Polytrichadelphus* seems only to be an occasional host. Within a rather rich collection of *P. innovans* from New Zealand (collection 20) a few intermingled plants of *Polytrichum juniperinum* were heavily infected by *Potridiscus polymorphus,* whereas no ascomata could be detected on the predominant *Polytrichadelphus*.

Potriphila navicularis Döbbeler (DÖBBELER, Nova Hedwigia 62: 62, 1996)
Host: *Polytrichadelphus magellanicus* (and other Polytrichaceae)
Distribution on *P. magellanicus*: Chile, Argentina
Specimens examined: 2, 7, 9, 10, 12, 13, 15

Potriphila navicularis has a bipolar distribution type and is very frequent on *Polytrichastrum alpinum* (DÖBBELER 1996). On *Polytrichadelphus magellanicus*, as in nearly all southern hemisphere records, only the anamorphic state is present. In addition to normal leaves, bracts and scale leaves should also be screened. Usually only a few pycnidia are detectable on dozens of potential host plants. The host of *Potriphila navicularis* from the Auckland Islands is not *Polytrichadelphus magellanicus*, as recorded by DÖBBELER (1996), but *Polytrichastrum longisetum* (Brid.) G.L.Sm.

Potriphila neurogena Döbbeler (DÖBBELER, Haussknechtia Beih. 9: 88, 1999b)
Host: *Polytrichadelphus magellanicus*
Distribution: Chile, Argentina
Specimens examined: 1, 2, 7, 9, 10, 12, 13, 15
Ascomata also develop within male bracts surrounding the antheridia.

Rogellia nectrioidea Döbbeler (DÖBBELER, Haussknechtia Beih. 9: 91, 1999b)
Host: *Polytrichadelphus magellanicus*
Distribution: Chile, Argentina
Specimens examined: 1, 4, 7, 10, 13
In several cases the ascomata of both *Rogellia nectrioidea* and *Potriphila neurogena* were observed on the same host leaf.

Geographical range of *Polytrichadelphus magellanicus* and *P. innovans*

Austral populations of *Polytrichadelphus* are often regarded as a single species, *P. magellanicus*. All of the herbarium material cited (specimens 1–38) was determined as *P. magellanicus* (specimen 7 as *P. horridus* Mitt.). However, SMITH (1971) considers *Polytrichadelphus* of New Zealand and Australia as a distinct taxon, *P. innovans*. "Compared with the American *P. magellanicus*, the plants are smaller and more slender, with shorter, subsecund leaves. The leaf sheath is broader, with more pronounced shoulders, and the teeth on the margin of the blade less well developed" (SMITH 1971: 41). He additionally noted differences in capsule morphology. Moreover, the presence of two distinct species is clearly indicated by completely different lamellae hair types as documented by DÖBBELER (1999a) and repeatedly observed in this study. If one accepts *P. innovans* as a distinct taxon, then *P. magellanicus* s.str. is confined to Chile and Argentina south of about 40 latitude, the Fuegian region, Juan Fernández Islands, the Falkland Islands, Tristan da Cunha and Gough Island (GREENE 1986, HE 1998, PROCTOR 1992, ROBINSON 1975, SCHIAVONE 1993, SCHIAVONE & HYVÖNEN 1992, SMITH 1971). The assumed disjunct occurrence in the northern Andes of Peru (SCHULTZE-MOTEL & MENZEL 1987, GRADSTEIN& FRAHM 1987, MENZEL 1992) is based on a BRYOTROP-specimen [Peru. Dep. Amazonas, Prov. Chachapoyas, road Chachapoyas-Cajamarca km 413, mountain rain forest, 3000 m, 5.9.1982, *Frahm, Geissler, Gradstein, Philippi & Schultze-Motel 916* (Herbarium Frahm!). Female plants with only one capsule and several successive, apparently lateral setae typical for the genus *Polytrichadelphus*.]. This species clearly differs by habit and leaf lamellae characters from the southern South American *Polytrichadelphus magellanicus*. The Australasian *P. innovans* is known from New Zealand, southeastern Australia, Tasmania, the Auckland Islands and Campbell Island (SMITH 1971, VITT 1974, 1979).

Comparison of the ascomycetes on *Polytrichadelphus magellanicus* and *P. innovans*

Careful analysis of forty-six collections of both species of *Polytrichadelphus* revealed the presence of ten different ascomycetes, eight only present on the American, one only on the Australasiatic host and one common to both. Of the seventeen collections of *Polytrichadelphus magellanicus* from Chile and Argentina, fifteen are infected by one to seven species of ascomycetes. Altogether fifty-eight specimens of ascomycetes are found, on average nearly four

on each host collection. Thus *P. magellanicus* represents one of the best hosts, not only within Polytrichaceae but also within bryophytes in general, with regard to the number of associated fungi and the frequency of infection. *Dawsophila polycarpa*, the most common species, is present on fourteen host specimens; *Crocicreas magellanicum*, on twelve; *Potriphila neurogena*, on eight; *P. navicularis*, on seven; *Rogellia nectrioidea*, on five; *Bryochiton perpusillus* and *Epibryon eremita*, on four and *Potridiscus polymorphus*, on one host collection. Twenty-eight specimens of *Polytrichadelphus innovans* from New Zealand, Australia and Tasmania and one collection from the Auckland Islands were examined. Twenty-three proved to be colonised. *Epibryon pogonati-urnigeri* was present on twenty-two specimens, whereas *Bryochiton perpusillus* was encountered only twice. This means that on average only one associated fungus per host collection was found.

The present inventory should not imply that the fungal diversity of the two austral species of *Polytrichadelphus* is completely covered. Only the more frequent, previously described parasites are discussed. On several occasions ascomata of an undescribed species were detected but are not discussed in this paper. In most cases the potential hosts consisted of only a few plants gathered for bryological purposes. More extensive collections are required to obtain a sufficient number of ascomata for a proper investigation of the other sparsely distributed parasites. Field studies are also required to seek out the relatively conspicuous, necrotrophic fungi that are unlikely to be represented in bryophyte herbarium material. An example is *Lizonia*, which occupies the antheridial cups of various polytrichaceous mosses. One should also search for orange coloured apothecia formed on the ground between individual plants, as they may belong to rhizoidparasitic species of *Octospora* or *Leucoscypha*. Whether *Polytrichadelphus* belongs to the host range of the latter genera and also *Lizonia* is not currently clear.

Interpretation of bryomycological evidence

The most surprising result of this bryomycological analysis is the diversity of the fungal associates of the two austral species of *Polytrichadelphus* studied. Only one species out of ten was encountered several times on both hosts, namely *Bryochiton perpusillus*, a very common and critical taxon which is also recorded from hepatics. Five ascomycete species are known exclusively on *P. magellanicus* s.str., among them *Potriphila neurogena* and *Rogellia nectrioidea*. The latter two species develop within the leaf nerves, a distinct niche rarely occupied by the multitude of polytrichophilous ascomycete species.

The marked differences in suitability of the two moss species as hosts was also unexpected. *Polytrichadelphus magellanicus* is an excellent substrate, whereas *P. innovans* is less attractive. The absence of common fungal parasites supports the distinctness of both moss taxa as has already been shown by morphological features. Another question concerns the phylogenetic relationship of the *Polytrichadelphus* species. Geographical isolation even for long geological periods does not automatically lead to genetic diversification as demonstrated by FREY et al. (1999) using molecular methods. In the ancient *Lopidium concinnum* (Musci) which has exactly the same distribution range as *P. magellanicus* s.l. little genetic divergence has occurred within the isolated populations since their separation by geotectonic events about 80–60 million years ago.

The vicariant taxa *P. magellanicus* and *P. innovans* (SMITH 1972: 46) are "undoubtedly closely related" (PROCTOR 1992: 317). This inferred relationship is not mirrored by an overlap of the more significant fungal parasites. Furthermore, *Dawsophila* frequently colonises various species of *Dawsonia* (DÖBBELER 1981) and *P. magellanicus*, but avoids *P. innovans*. *Epibryon elegan-*

tissimum occurring on *Dawsonia* and *E. eremita* infecting *P. magellanicus* seem to represent a further link between Australasian and South American polytrichaceous hosts, leaving *P. innovans* apart. The bryomycological facts documented herein indicate that *P. magellanicus* and *P. innovans* have had a very long, separate evolution. It would be interesting to know more about the ascomycetes on the relatives of *Polytrichadelphus*, both in South America and Australasia.

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Dr. Peter DÖBBELER, Institut für Systematische Botanik der Ludwig-Maximilians-Universität München, Menzinger Straße 67, D-80638 München, Deutschland.

Table 1: The hosts, the associated ascomycetes and their frequency (by number of specimens recorded).

Fifteen specimens of *Polytrichadelphus magellanicus* s.str. (southern South America) are infected by:	
Bryochiton perpusillus	(4)
Crocicreas magellanicum	(12)
Dawsophila polycarpa	(14)
Epibryon eremita	(4)
Epibryon interlamellare	(3)
Potridiscus polymorphus	(1)
Potriphila navicularis	(7)
Potriphila neurogena	(8)
Rogellia nectrioidea	(5)

Twenty-three specimens of *Polytrichadelphus innovans* (Australasia) are infected by:	
Bryochiton perpusillus	(2)
Epibryon pogonati-urnigeri	(22)

Table 2: The infected specimens of *Polytrichadelphus magellanicus* and *P. innovans* and their parasitic ascomycetes.

Host	*Polytrichadelphus magellanicus*														
Areas	Chile										Argentina				
Nr. of collection	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bryochiton perpusillus			●			●		●			●				
Crocicreas magellanicum	●	●	●		●	●		●	●	●	●	●	●		●
Dawsophila polycarpa	●	●		●	●	●	●	●	●	●	●	●	●	●	●
Epibryon eremita							●					●	●		●
Epibryon interlamellare												●	●		●
Epibryon pogonati-urnigeri															
Potridiscus polymorphus							●								
Potriphila navicularis		●					●		●	●		●	●		●
Potriphila neurogena	●	●					●		●	●		●	●		●
Rogellia nectrioidea	●			●			●			●			●		

Host	*Polytrichadelphus innovans*																						
Areas	New Zealand																A.I.	Australia			Tasmania		
Nr. of collection	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Bryochiton perpusillus							●							●									
Crocicreas magellanicum																							
Dawsophila polycarpa																							
Epibryon eremita																							
Epibryon interlamellare																							
Epibryon pogonati-urnigeri	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Potridiscus polymorphus																							
Potriphila navicularis																							
Potriphila neurogena																							
Rogellia nectrioidea																							

Zephyra compacta (Tecophilaeaceae) – eine neue Art aus Chile

C. EHRHART

Zusammenfassung:
EHRHART, C.: *Zephyra compacta* (Tecophilaeaceae) – eine neue Art aus Chile. – Sendtnera 7: 47–52. 2001. ISSN 0944–0178.

Aus dem Küstenbereich des nördlichen Chile (IV Region de Coquimbo, Prov. de Elqui, 29°17'S – 71°18'W) konnte im Niño-Jahr 1997 eine neue Tecophilaeacee der Gattung *Zephyra* gesammelt werden. Sie wird hier als *Zephyra compacta* spec. nov. beschrieben. Sie unterscheidet sich von der bislang einzigen Art der Gattung, *Zephyra elegans* D.Don durch den viel kompakteren Wuchs, durch die reichverzweigte, aus bis zu 15 Partialfloreszenzen zusammengesetzte Infloreszenz, die breiteren, fleischigeren Blätter/Tragblätter und die deutlich kleineren, reinweißen Blüten mit Tepalen, die im Gegensatz zu den Tepalen von *Z. elegans* nicht radförmig ausgebreitet, sondern zum Blütenstiel eingerollt sind.

Resumen:
Durante el año del Niño 1997 se colectó en la zona costera del norte de Chile (IV Región de Coquimbo, Prov. de Elqui, 29°17'S – 71°18'W) una especie nueva del género *Zephyra* (Tecophilaeaceae), que se describe como *Zephyra compacta* spec. nov. Este nuevo taxon se distingue de la única especie del género hasta ahora conocida, *Zephyra elegans* D.Don, por su hábito compacto, su inflorescencia muy ramificada, por sus hojas más anchas y más suculentas, por sus flores blancas con tépalos, que son a diferencia de los tépalos de *Z. elegans*, mucho más pequeños y no planos pero curvados hacia el envés.

Einleitung

Von der als monotypisch geltenden Gattung *Zephyra* kannte man bislang nur die im Küstenbereich des nördlichsten Chile (von der I. Region Tarapacá bis etwa zur III. Region Atacama) weitverbreitete *Zephyra elegans* D.Don. Im Niño-Jahr 1997 konnten während einer Sammelreise im Küstengebiet zunächst wenig nördlich von La Serena aus der IV. Region, später auch noch etwa 100 km weiter nördlich, Populationen von *Zephyra* gesammelt werden, die sich in mehreren Merkmalen von *Z. elegans* unterscheiden. Diese Pflanzen sind wesentlich gedrungener gebaut, die Infloreszenz ist viel reicher verzweigt, und auch im Blütenbereich finden sich deutliche Unterschiede zu *Z. elegans*. Es handelt sich augenscheinlich um eine gut differenzierte Art, die hier als *Zephyra compacta* neu beschrieben wird.

Vom Wildstandort konnten sowohl Samen, als auch Lebendmaterial in Form von Knollen gesammelt und in München erfolgreich kultiviert werden. Dabei hat sich gezeigt, daß die

Merkmale der Art weitgehend konstant sind. Dies ist umso wichtiger in der Beurteilung der Abgrenzung der beiden Arten, da *Z. elegans*, wie sich bei Populationen verschiedener Wildstandorte zeigte, in einigen Merkmalen relativ variabel zu sein scheint und es damit erst zu klären galt, ob *Z. compacta* nicht nur als eine weitere, in das Variabilitätsspektrum von *Z. elegans* fallende Form anzusehen ist. Die Kultur von Wildmaterial mehrerer Aufsammlungen beider Arten zeigte jedoch keine kontinuierliche Verbindung zwischen den beiden Arten, so daß eine Etablierung dieser südlichsten Populationen als eigene Art gerechtfertigt ist.

Zur Taxonomie von *Zephyra*

Die monotypische Gattung *Zephyra* mit *Zephyra elegans* wurden 1832, basierend auf einer Aufsammlung von Boellaert, von Don beschrieben. 1864 glaubte Miers *Zephyra*-Belege, die ebenfalls von Boellaert gesammelt worden waren, als eine neue Art ansprechen zu können und benannte sie *Zephyra amoena*. Nach Überprüfung der Typusbelege beider Taxa steht fest, daß es sich bei *Z. amoena* um ein Synonym von *Z. elegans* handelt und die Beschreibung von *Z. amoena* höchstwahrscheinlich sogar auf der gleichen Aufsammlung von Boellaert beruht. Miers hat vermutlich nur Teilstücke einer Pflanze gesehen, zumindest zeigen die beiden Typusbelege von *Z. amoena* in BM ganz eindeutig einen Teilbereich der Infloreszenz, wie er für *Z. elegans* charakteristisch ist. Die von Miers beschriebenen Merkmalsunterschiede der beiden Arten liegen durchaus im Variabilitätsbereich der Merkmale von *Z. elegans*.

Offensichtlich in Unkenntnis der Existenz von *Zephyra*, beschrieb Philippi 1873 eine neue Gattung *Dicolus* mit der einzigen Art *Dicolus caerulescens* Phil., die nach Typus und Diagnose ebenfalls völlig mit *Z. elegans* übereinstimmt und in die Synonymie zu dieser zu stellen ist. Die Typusaufsammlung von Philippi stammt von Carrizal Bajo (III. Region), einem Gebiet südlich von Copiapó, in dem *Z. elegans* auch in jüngster Zeit häufig gesammelt werden konnte.

Einer Zusammenfassung der Gattungen *Tecophilaea* und *Zephyra* unter *Zephyra*, wie sie 1988 RAVENNA vorschlug, kann nicht zugestimmt werden. Wie er selbst erkannte, trennt die beiden Gattungen ein ganz wesentlicher Unterschied im generativen Bereich: *Tecophilaea* besitzt drei Staminodien, *Zephyra* dagegen nur zwei. Die relative Merkmalsarmut vieler großblütiger Monokotylen, so auch der Vertreter der Tecophilaeaceae, geben dem genannten Unterschied eine große Bedeutung.

Zephyra compacta C.Ehrhart, spec. nov.

Holotypus: Chile, IV Región, Prov. de Elqui: Quebrada Los Choros, Sandflächen westlich Choros Bajos, 20.10.1997, *Ehrhart & Grau 97/1147* (M; Iso SGO, CONC).

Planta perennis, bulbosa, plerumque pluricaulis, caulibus erectis, valde ramosis, ad 12–20 cm altis; inflorescentia sessilis, paniculata, compressa, in inflorescentiis partialibus ad 15 divisa, etiam in axillis foliorum basalium inflorescentiae partiales surgentes; internodia ad 2 cm longa; folia radicalia parte basali amplexicaulia et carnosa, ad 15 cm longa et 14 mm lata; folia media ad 12 mm lata et carnosa, folia ultima distincte minora et lineari-lanceolata. Flores numerosi albi; tepali ad 7 mm longa apice mucronata reflexa, 3 inferioribus paulum latioribus, basaliter canaliculatis et marginibus ciliatis. Capsula ad 12 mm longa et 8 mm lata. Semina acuti-elliptica ad 2,2 mm longa, atrofusca, grosse rugosa. Numerus chromosomatum $2n = 2x = 26$.

Weitere bekannte Aufsammlungen:

Chile. III Región. Prov. de Huasco: ca. 10 km westlich Canto del Agua, Quebrada, 25.10.1997, *Ehrhart & Grau 97/1281* (M). – **IV Región**. Prov. de Elqui: Carretera Panamericana a Choros Bajos km 5, 250 m, 21.10.1971, *Marticorena, Rodríguez & Weldt* 1673 (CONC 35536).

Zephyra compacta überdauert mit bis zu 12 cm tief im Boden verborgenen Knollen, die – ähnlich wie bei anderen Tecophilaeaceen – außen von den trockenen Resten der Leitbündel als feines Netz umhüllt sind. Von einer Knolle können mehrere Sprosse gleichzeitig ausgehen. Die oberirdischen Sprosse messen selten mehr als 15 cm, sind reich verzweigt, die Internodien der Hauptachse erreichen meist nur 2 cm Länge. Die leicht sukkulenten, flachen Blätter sind in sich rinnig gebogen und schmiegen sich jeweils etwa im unteren Drittel dem Sproß eng an; sie sind bis zu 15 cm lang und 14 mm breit. Bereits aus den Achseln der ersten grundständigen Blätter entstehen meist schon blühende Seitensprosse, so daß der gesamte oberirdische Sproß der Pflanze im Prinzip eine Infloreszenz darstellt. Diese kann sich aus bis zu 15 Teilinfloreszenzen zusammensetzen. Zumindest die basalen Teilinfloreszenzen tragen bis zu 25 Blüten. Die Tragblätter der Teilinfloreszenzen nehmen zu den distalen Knoten hin nur allmählich an Länge und Breite ab und sind hier noch bis zu 2 cm lang und 5 mm breit. Die Blüten sind immer rein weiß und messen nicht mehr als 10 mm im Durchmesser; sie sind wie die Blüten von *Z. elegans* leicht asymmetrisch gebaut. Von den äußeren, mit einer grünlich-fleischigen Spitze versehenen, bis zu 2,5 mm breiten und etwa 5 mm langen Tepalen ist das abaxiale Tepalum immer etwas schmäler; die leicht breiteren inneren Tepalen sind basal rinnig zusammengedrückt, der Rand ist in diesem Bereich leicht gekräuselt und mit fädigen Auswüchsen besetzt. Von den sechs Staubblättern sind im äußeren Kreis die beiden adaxialen steril, die drei des inneren Kreises sind fertil; die fertilen Staubblätter sind bis zu 2 mm lang, die Filamente sind grün und leicht fleischig; die gelb gefärbten Antheren öffnen sich apikal mit je einer großen Öffnung pro Theka; die sterilen Staubblätter bestehen nur aus den grünlichen, fleischigen Filamenten. Der monocolpate Pollen mißt bis zu 23 µm in der Länge und 14 µm in der Breite. Die Frucht ist eine trockenhäutige, dreikantige, vielsamige Kapsel mit kleinen Flügelleisten an den Verwachsungsnähten, die sich apikal öffnet. Der eiförmige, leicht zugespitzte, dunkelbraune Same mißt ca. 1,2 mm im Durchmesser und besitzt eine leicht runzelige Oberfläche. Die Chromosomenzahl ist $2n = 2x = 26$.

Vergleich mit *Z. elegans*

Z. elegans besitzt, wie schon eingangs erwähnt, in einigen Merkmalen eine gewisse Plastizität, die durch den Vergleich von einer breiteren Besammlung und Kultivierung noch untersucht werden sollte. Vor allem die Tepalenlänge ist nicht besonders festgelegt und schwankt zwischen 12 und 20 mm, und auch die Blütenfarbe kann von überwiegend weiß bis fast vollständig blau variieren. Die geringe Tepalenlänge war auch der Hauptunterschied, der Miers zur Beschreibung von *Z. amoena* veranlasste. Wie sich aber gezeigt hat, variiert die Länge an ein und demselben Individuum in diesen Grenzen, so daß dieses Merkmal nicht zur Unterscheidung einer Art ausschlaggebend sein kann. Die Tepalen bei *Z. compacta* hingegen sind innerhalb der Population ganz einheitlich und mit Abstand kleiner, als die von *Z. elegans*. Die „eleganten" Blüten von *Z. elegans* sind außerdem immer ± flach radförmig ausgebreitet, während die Tepalen von *Z. compacta* an der Spitze nach hinten eingerollt sind.

Die auffälligsten Unterschiede zwischen den beiden Arten zeigen sich allerdings im Wuchs: Im Gegensatz zu *Z. elegans*, bei der sich pro Knolle jeweils nur ein Sproß ausbildet, entwickeln sich bei *Z. compacta* sehr häufig mehrere Sprosse gleichzeitig. Auffällig ist außerdem der hohe, schlanke Wuchs bei *Z. elegans*, während die gedrungenen, kompakten Sprosse von *Z. compacta* sich kaum über den Boden erheben. Die prinzipiell gleichen Standortsbedingungen, die für beide Arten gelten, geben diesen Unterschieden einiges Gewicht. Bei *Z. elegans* hebt sich die Infloreszenz durch ein lang gestrecktes Internodium weit vom Boden ab, während dieses bei *Z. compacta* gestaucht ist und die ersten Teilinfloreszenzen schon aus den Achseln der untersten Laubblätter entstehen. Die schmalen, vom Sproß abspreizenden Blätter von *Z. elegans*, die als Tragblätter der Teilinfloreszenzen distal schnell zu sehr schmalen und nicht einmal 1 cm langen Blättchen reduziert sind, heben

sich deutlich gegenüber den wesentlich breiteren, dem Sproß stärker angeschmiegten Blättern von *Z. compacta* ab, die auch als Tragblätter der oberen Teilinfloreszenzen noch ihre breite, fleischige Gestalt behalten. Tabelle 1 gibt einen Überblick über die Merkmale der beiden Arten im Vergleich.

In den ökologischen Ansprüchen unterscheiden sich die beiden Arten von *Zephyra* kaum. Beide kommen auf sandigem bis sandig-steinigem Boden im Bereich der Küste bis wenige km ins Landesinnere hin vor. Das Areal der neuen Art schließt sich südlich an das Areal von *Z. elegans* an. In einem überraschenden zweiten Fundort von *Z. compacta* etwa 100 km weiter nördlich des Erstfundes konnten beide Arten sympatrisch wachsend gesammelt werden – was auch für die Eigenständigkeit von *Z. compacta* spricht: *Z. elegans* direkt an der Küste in ihrer typischen schlanken, hohen Gestalt und *Z. compacta* etwa 15 km weiter im Landesinneren bei Canto del Agua; erstere in voller Blüte, letztere bereits fruchtend, unverkennbar allerdings in ihrer typischen gedrungenen Gestalt. Dieser zweite Fundort zeigt, daß es sich bei *Z. compacta* nicht um eine lokale Entwicklung, d.h. eine relativ junge Abspaltung von *Z. elegans* handelt, sondern daß die Art doch eine weitere Verbreitung besitzt, wobei das heutige Areal relativ zerrissen erscheint (oder schlecht besammelt ist?). *Z. compacta* könnte daher als eine ältere, durchaus etablierte Art betrachtet werden, die nicht eine junge, durch relativ rezente klimatische Veränderungen entstandene Entwicklung darstellt. Leider konnte die zweite, nördlichere Aufsammlung von *Z. compacta* noch nicht kultiviert werden; interessant wäre es jedoch zu sehen, ob sich zwischen den beiden Aufsammlungen bereits Unterschiede zeigen.

Tabelle 1: Merkmalsvergleich von *Z. compacta* mit *Z. elegans*

	Z. compacta	*Z. elegans*
Wuchshöhe	12–20 cm	25–40 cm
Knolle	mit mehreren Sprossen pro Knolle	mit nur einem Sproß pro Knolle
Blätter	bis 15 cm lang, max. 14 mm breit im basalen Drittel den Sproß ± umhüllend	bis 22 cm lang, max 8 mm breit vom Sproß abspreizend
Tragblätter der Teilinfloreszenzen	immer auffällig laubblattartig entwickelt; die unteren bis zu 14 mm breit und auch die oberen an den distalen Knoten bis zu 2 cm lang und 5 mm breit	unauffällig, nur das der untersten 1–2 Teilinfloreszenzen laubblattähnlich und bis zu 4 mm breit, die Tragblätter der oberen Teilinfloreszenzen nur noch fädig dünn
Verzweigungsgrad der Infloreszenz	hoch: bereits aus den Achseln der untersten Blätter der erste Seitentrieb der Infloreszenz auszweigend mit bis zu 15 Teilinfloreszenzen	gering: nach ein bis zwei langgestreckten Internodien, d.h. erst aus der zweiten oder dritten Blattachsel ein Seitentrieb der Infloreszenz auszweigend meist mit nicht mehr als 7 Teilinfloreszenzen
Internodienlänge zwischen den Teilinfloreszenzen	1–2(–3) cm	5–8 cm
Blütenfarbe	rein weiß	weiß mit blau überlaufenen Spitzen oder rein blau
Länge der Tepalen Breite der Tepalen	4–7 mm 1,5–3,5 mm	12–20 mm bis 8 mm

Abb. 1: *Zephyra elegans* bei Carrizal Bajo (*Ehrhart & Grau 97/1260* (M))

Abb. 2: *Zephyra compacta* bei Choros Bajos (*Ehrhart & Grau 97/1147* (M))

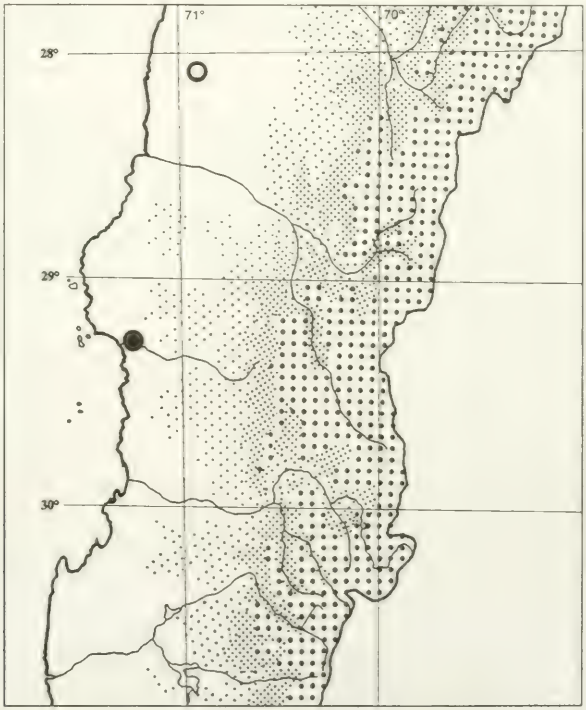

Abb. 3: Fundorte von *Z. compacta*:
● = Typusaufsammlung (*Ehrhart & Grau 97/1147* (M))
○ = Fundort bei Canto del Agua (*Ehrhart & Grau 97/1281* (M))

Den Konservatoren von BM möchte ich für die rasche Ausleihe der Typen von *Zephyra* danken. Herrn Craig Brough (Kew) danke ich für seine Hilfe in der Literaturbeschaffung.

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Dr. Christine EHRHART, Institut für Systematische Botanik der Ludwig-Maximilians-Universität München, Menzinger Str. 67, D-80638 München, Deutschland.

Bemerkungen zur Taxonomie der Gattung *Limonium* VII

M. ERBEN

Zusammenfassung:
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Acht neue Arten werden für die Gattung *Limonium* beschrieben. *L. portovecchiense* wächst auf Korsika. *L. caralitanum, L. multifurcatum, L. capitis-eliae, L. malfatanicum* und *L. carisae* kommen auf Sardinien vor. *L. fesianum* und *L. comosum* haben ihr Areal in Marokko bzw. in Tunesien. Da sich *L. coralliforme* nicht von *L. ursanum* unterscheiden läßt, wird es nun als Synonym der zuletzt genannten Art geführt. *Statice bollei* wurde zu *Limonium bollei* umkombiniert. *L. dubium* und *L. tunetanum* wurden durch die Auswahl eines Lectotypus typifiziert.

Abstract:
Eight new species are described of the genus *Limonium*. *L. portovecchiense* grows in Corsica. *L. caralitanum, L. multifurcatum, L. capitis-eliae, L. malfatanicum* and *L. carisae* are from Sardinia. *L. fesianum* and *L. comosum* are locally distributed within Marocco and Tunisia. *L. coralliforme* does not differ from *L. ursanum*, therefore has been reduced to a synonym of the latter name. *Statice bollei* has been recombined as *Limonium bollei*. The typification of *L. dubium* and *L. tunetanum* is completed by the selection of lectotypes.

I. Neue Taxa

1. ***Limonium portovecchiense*** Erben, spec. nov.
Holotypus: Korsika, Dépt. Corse-du-Sud: Nordöstlich von Porto-Vecchio, Golfo di Sogno, ca. 2 km östlich von Sta.-Trinité an der Straße D 468, auf feucht-sandigen Flächen am Meer, 5.9.1990, *Erben E 872* (MSB 85555; Isotypen: Herb. Erben).

Abb.: 1–2

Planta perennis, glabra, pluricaulis. Caudiculi 10–80 mm longi, in parte superiore laxe ad dense ramosi. Folia florendi tempore persistentia, dense rosulate disposita, 15–80 mm longa et 4–12 mm lata, oblanceolata ad spatulata, acuta ad obtusa, sublaevia, 1–3-nervia, in petiolum 1/3 longitudinis laminae attingentem 1–3 mm latum sensim attenuata. Caules 15–40 cm longi, erecti, flexuosi, in partibus 3/4 ad 2/3 superioribus ramosi. Rami laxe distiche dichotomiforme dispositi, oblique sursum spectantes, sub angulis 40°–50° abeuntes, inferiores 1–3 steriles, non ramosi, 2–6 cm longi, superiores fertiles, 5–20 cm longi, recti ad subflexuosi, laxe secunde ad distiche ramosi. Inflorescentia paniculata, plana, forma obtrullata ad

cuneata. Spicae in parte 1/4 superiore inflorescentiae dispositae, 5–50 mm longae, subrectae; axis spicae subtiliter flexuosus. Spiculae 5,5–6,5 mm longae, laxe ad 2–5 in 1 centimetro dispositae, non vel partim mutue attingentes. Bractea inferior 1,9–2,3 mm longa et 1,9–2,0 mm lata, triangulari-ovata, acuta, margine anguste membranaceo, parte centrali subcarnosula, acuminata, acumine tenui marginem fere contingente. Bractea media membranacea, 1,9–2,2 mm longa et 1,7–2,0 mm lata, late elliptica, rotundata. Bractea superior 5,0–5,3 mm longa et 3,6–4,0 mm lata, elliptica, obtusa, dorso longitudinaliter subarcuata, margine late membranaceo, parte centrali subcarnosula, subdura, 3,6–4,1 mm longa et 1,9–2,2 mm lata, oblongo-elliptica, acuminata, acumine 1,0–1,2 mm longo marginem fere contingente. Calyx fere infundibuliformis, 5,0–5,7 mm longus, ex bractea superiore 1,0–1,5 mm exsertus, tubo imprimis in parte inferiore unilateraliter sparsim breviter piloso; dentes calycis ca. 0,4 × 1,0 mm, transverse late semi-elliptici; costae tubi ad vel breviter supra basim dentium calycis desinentes. Flores caeruleo-violacei, diametro 7,5–8,0 mm. Chromosomatum numerus: 2n = 27.

Pflanze ausdauernd, kahl, mehrstengelig. Stämmchen 10–80 mm lang, am oberen Ende locker bis dicht verzweigt. Blätter dicht rosettig angeordnet, bei älteren Pflanzen die unteren braun und verwelkt, die oberen grün und lebend, ganzrandig, 15–80 mm lang und 4–12 mm breit, oblanzeolat bis spatelförmig, am oberen Ende spitz bis stumpf, an den Rändern sehr schmal weißhäutig, nahezu glatt, kleinere Blätter 1-, größere 3-nervig, allmählich in einen 1–3 mm breiten, ca. 1/3 der Spreitenlänge erreichenden Stiel übergehend. Stengel 15–40 cm lang, aufrecht, mehr oder weniger zickzackförmig gebogen, ab dem unteren Viertel bis Drittel verzweigt. Äste locker dichotomartig abzweigend, meist zweiseitswendig angeordnet, schräg nach oben gerichtet (Verzweigungswinkel 40°–50°), die unteren 1–3 steril, unverzweigt, 2–6 cm lang, die oberen fertil, 5–20 cm lang, gerade bis schwach zickzackförmig gebogen, locker ein- oder zweiseitswendig verzweigt. Infloreszenz flach, rispenförmig, im Umriss obtrullat bis dreieckig-eiförmig. Ähren im oberen Viertel der Infloreszenz sitzend, 5–50 mm lang, nahezu gerade; Ährenachse fein zickzackförmig gebogen. Ährchen 5,5–6,5 mm lang, 2–4-blütig, locker zu 2–5 pro Zentimeter angeordnet, sich gegenseitig nicht oder nur teilweise berührend. Äußere Braktee 1,9–2,3 mm lang und 1,9–2,0 mm breit, dreieckig-eiförmig, am oberen Ende spitz, häufig leicht gekielt; Rand schmal weißhäutig; zentraler Bereich etwas fleischig, mit einer feinen, fast bis zum Rand reichenden Spitze. Mittlere Braktee häutig, 1,9–2,2 mm lang und 1,7–2,0 mm breit, breit elliptisch, am oberen Ende abgerundet. Innere Braktee 5,0–5,3 mm lang und 3,6–4,0 mm breit, elliptisch, am oberen Ende stumpf, am Rücken in Längsrichtung schwach bogenförmig; Rand breit weißhäutig; zentraler Bereich etwas fleischig und ziemlich hart, 3,6–4,1 mm lang und 1,9–2,2 mm breit, länglich-elliptisch, mit einer 1,0–1,2 mm langen, fast bis zum Rand reichenden Spitze. Kelch annähernd trichterförmig, 5,0–5,7 mm lang, die innere Braktee um 1,0–1,5 mm überragend; Kelchröhre nur in der unteren Hälfte auf einer Seite spärlich kurz behaart; Kelchzähne sehr zart, ca. 0,4 × 1,0 mm, transvers breit halbelliptisch; Rippen der Kelchröhre an oder kurz unterhalb der Kelchzahnbasis endend. Blüten blau-violett, mit einem Durchmesser von 7,5–8,0 mm. Chromosomenzahl: 2n = 27; untersucht wurden Exemplare der Aufsammlungen Li-574, Li-1258, Li-1274, Li-1315 und Li-1519.

Limonium portovecchiense ist sicher näher mit *L. glomeratum* (Tausch) Erben verwandt. Da beide Arten in mehreren Merkmalen übereinstimmen, die sie von anderen Sippen stärker trennen, erschien mir zunächst eine Zusammenfassung beider Sippen zu einer Art die sinnvollste Lösung zu sein. Nun haben aber Kulturversuche mit *L. portovecchiense* und *L. glomeratum* gezeigt, dass sich beide Arten in Kultur noch viel deutlicher von einander unterscheiden als an ihren Wildstandorten. Da diese Eigenschaften also genetisch fixiert sein dürften, erscheint mir auch die Behandlung dieser Sippen als zwei selbständige Arten gerechtfertigt.

Abb. 1: *Limonium portovecchiense* Erben

Abb. 2: a: Ährchen; b: äußere Braktee; c: mittlere Braktee; d: innere Braktee (Seitenansicht); e: innere Braktee (Rückenansicht); f: Kelch; g: Kelchzähne. Maßstab: 1 mm.

Limonium portovecchiense unterscheidet sich von *L. glomeratum* vor allem durch im Verhältnis zur Länge schmälere Blätter, die vorwiegend nach außen gerichtet sind, kürzere und zartere Stengel und Äste, den Besitz von mehr sterilen Ästen, durch längere Ähren sowie durch lockerer angeordnete und deutlich dickere Ährchen.

Diese neue Art besitzt nur ein punktförmiges Areal im Nordosten von Porto-Vecchio, das sich vom Golfo di Sogno bis zur Mündung des Oso-Flusses erstreckt, und bevorzugt feuchtsandige Böden in Meeresnähe.

Untersuchte Aufsammlungen:

Korsika. Dépt. Corse-du-Sud: Westlicher, verlandeter Arm der Oso-Mündung östlich St.-Trinité, nordöstlich Porto-Vecchio, auf Sand, 2.8.1979, *Lewejohann Co-79-151* (Li-574) (GOET, Herb. Erben) – Porto-Vecchio, village de vacances Paese Serenu. Large fossé saumâtre débouchant en bord de plage, 17.7.1999, *Lambinon 99/Co/365* (Li-1519) (LG, Herb. Erben) – Nordöstlich von Porto-Vecchio, Golfo di Sogno, ca. 2 km östlich von St.-Trinité an der Straße D 468, sandig-sumpfige Stellen am Meer, 5.9.1990, *Erben E 853* (Li-1274), *E 853a* (Li-1258) und *E 872* (Li-1315) (MSB, Herb. Erben).

Limonium portovecchiense Erben **x** ***L. virgatum*** (Willd.) Fourr.

Da am Fundort von *Limonium portovecchiense* auch *L. virgatum* wächst, ist es nicht verwunderlich, dass auch Bastarde zwischen diesen beiden Arten gebildet werden. Diese Hybridformen verhalten sich hinsichtlich ihrer Wuchsform intermediär. Von *L. portovecchiense* unterscheiden sie sich vorwiegend durch schmälere Blätter, die am oberen Ende meist stumpf bis rund sind, durch längere, schwach bogenförmig gekrümmte oder geschweifte Ähren und durch größere und – wie für *L. virgatum* typisch – seitlich eingekrümmte Ährchen.

Untersuchte Aufsammlungen:

Korsika. Dépt. Corse-du-Sud: Nordöstlich von Porto-Vecchio, Golfo di Sogno, ca. 2 km östlich von St.-Trinité an der Straße D 468, sandig-sumpfige Stellen am Meer, 5.9.1990, *Erben E 869* und *E 873* (Herb. Erben).

2. *Limonium caralitanum* Erben, spec. nov.

Holotypus: Sardinien, Prov. Cagliari: Kalkfelsen am Capo S. Elia, 9.9.1992, *Erben E 947* (MSB 85600; Isotypen: FI, Herb. Erben).

= *Limonium virgatum* (Willd.) Fourr. subsp. *sardoum* (Pignatti), Nuovo Giorn. Bot. Ital. ser. 2, 66: 562,1959 (nom. inval., holotypus omissa)

= *Limonium oleifolium* Miller subsp. *sardoum* (Pignatti) Pignatti, Bot. J. Linn. Soc. 64: 366, 1971 (nom. inval.)

= *Limonium sardoum* (Pignatti) Erben, Mitt. Bot. Staatssamml. München 16: 561, 1980 (nom. inval.)

= *Limonium retirameum* sensu Arrigoni & Diana, Boll. Soc. Sarda Sci. Nat. 28: 317, 1991, p.p.

Abb.: 3–4

Planta perennis, glabra, dense verrucosa, pluricaulis, frutex semi-globosa formans. Caudiculi 5–50 mm longi, in parte superiore ramosi. Folia rosulata, florendi tempore omnino vel partim emarcida, 10–45 mm longa et 1,5–5,0 mm lata, anguste oblanceolata ad anguste cuneato-spatulata, acuta ad obtusa, marginibus angustis subrevolutis, supra verrucosa, 1-nervia, in petiolum ca. 1/3 longitudinis laminae attingentem 1–2 mm latum attenuata. Caules 5–30 cm longi, dense verrucosi, erecti ad patentes, flexuosi, subarticulati, internodiis 3–12 mm, a

basi fere ramosi. Rami tenues, dense verrucosi, densissime spiraliter dispositi, in partibus 2/3–3/4 inferioribus caulis steriles, in partibus 1/3–1/4 superioribus fertiles, usque ad 5 cm longi, flexuosissimi, subarticulati, patentes ad oblique sursum spectantes, sub angulis 50°–70° abeuntes, densissime dichotomiforme ramosi; ramuli fere semper sub angulis supra 90° abeuntes. Inflorescentia paniculata, cylindrica ad conica. Spicae in apice inflorescentiae dispositae, 10–40 mm longae, interdum ad 1–2 spiculas reductae, rectae ad subarcuatae. Spiculae tenues, 5,5–6,0 mm longae, 1(–2)-florae, ad 4–6 in 1 centimetro dispositae, non vel partim mutue attingentes. Bractea inferior 1,3–1,7 mm longa et 1,2–1,5 mm lata, triangularis ad triangulari-ovata, acuta, margine late membranaceo, parte centrali subcarnosula, acuminata, acumine marginem fere contingente. Bractea media membranacea, 1,4–1,8 mm longa et 1,2–1,4 mm lata, oblongo-elliptica, rotunda vel asymmetrice biloba. Bractea superior 3,6–4,2 mm longa et 2,1–2,4 mm lata, elliptica, obtusa, margine plus minusve late membranaceo, parte centrali carnosa, 3,0–3,2 mm longa et 1,6–1,7 mm lata, oblongo-elliptica, acuminata, acumine 0,8–0,9 mm longo, marginem fere contingente. Calyx 4,6–5,3 mm longus, ex bractea superiore 1,8–2,5 mm exsertus, tubo imprimis unilateraliter sparsim breviter piloso; dentes calycis ca. 0,6 × 0,8 mm, semi-elliptici; costae tubi ad basim dentium calycis desinentes. Petala 7,3–7,5 mm longa et 2,0–2,2 mm lata, cuneato-spatulata, caeruleo-violacea. Corolla diametro 5,5–6,5 mm. Chromosomatum numerus: 2n = 18.

Pflanze ausdauernd, kahl, dicht mit Warzen besetzt, mehrstengelig, einen halbkugelförmigen Busch bildend. Stämmchen 5–50 mm lang, in der oberen Hälfte verzweigt. Rosettenblätter zur Blütezeit völlig oder zumindest teilweise verwelkt, 10–45 mm lang und 1,5–5,0 mm breit, sehr schmal oblanzeolat bis schmal spatelig-keilförmig, am oberen Ende spitz bis stumpf, mit einem schmalen, nach unten gebogenen Rand, oberseits warzig, 1-nervig; Stiel 1–2 mm breit, ca.1/3 der Spreitenlänge erreichend. Stengel 5–30 cm lang, dicht warzig, aufrecht bis ausgebreitet, zickzackförmig gebogen, an den Knoten leicht eingeschnürt, mit 3–12 mm langen Internodien; Verzweigung kurz über der Basis beginnend. Äste zart, dicht mit Warzen besetzt, sehr dicht allseitswendig angeordnet, in den unteren 2/3 –3/4 des Stengels steril, im oberen Drittel bis Viertel fertil, bis zu 5 cm lang, sehr stark zickzackförmig gebogen, an den Knoten schwach eingeschnürt, ausgebreitet bis schräg nach oben gerichtet (Verzweigungswinkel 50°–70°), mehrfach sehr dicht dichotomartig verzweigt; Ästchen fast immer einen Winkel über 90° bildend. Infloreszenz rispig, zylinder- bis kegelförmig. Ähren an der Spitze der Infloreszenz sitzend, 10–40 mm lang, gelegentlich auch nur aus 1–2 Ährchen bestehend, gerade bis leicht gekrümmt. Ährchen zart, 5,5–6,0 mm lang, 1(–2)-blütig, zu 4–6 pro Zentimeter angeordnet, sich gegenseitig nicht oder nur teilweise berührend. Äußere Braktee 1,3–1,7 mm lang und 1,2–1,5 mm breit, dreieckig bis dreieckig-eiförmig, am oberen Ende spitz; Rand breit häutig; zentraler Bereich nur etwas fleischig, mit einer fast bis zum Rand reichenden Spitze. Mittlere Braktee häutig, 1,4–1,8 mm lang und 1,2–1,4 mm breit, länglich-elliptisch, am oberen Rand rund oder asymmetrisch zweilappig. Innere Braktee 3,6–4,2 mm lang und 2,1–2,4 mm breit, elliptisch, am oberen Ende stumpf; Rand mehr oder weniger breit häutig; zentraler Bereich fleischig, 3,0–3,2 mm lang und 1,6–1,7 mm breit, länglich-elliptisch, mit einer 0,8–0,9 mm langen, fast bis zum Rand reichenden Spitze. Kelch 4,6–5,3 mm lang, die innere Braktee um 1,8–2,5 mm überragend; Kelchröhre vor allem auf einer Hälfte spärlich, kurz behaart; Kelchzähne ca. 0,6 × 0,8 mm, halbelliptisch; Rippen der Kelchröhre an der Kelchzahnbasis auslaufend. Kronblätter 7,3–7,5 mm lang und 2,0–2,2 mm breit, spatelig-keilförmig, blauviolett. Blütendurchmesser 5,5–6,5 mm. Chromosomenzahl: 2n = 18; untersucht wurden Exemplare der Aufsammlungen Li-622 und Li-624.

Abb. 3: *Limonium caralitanum* Erben

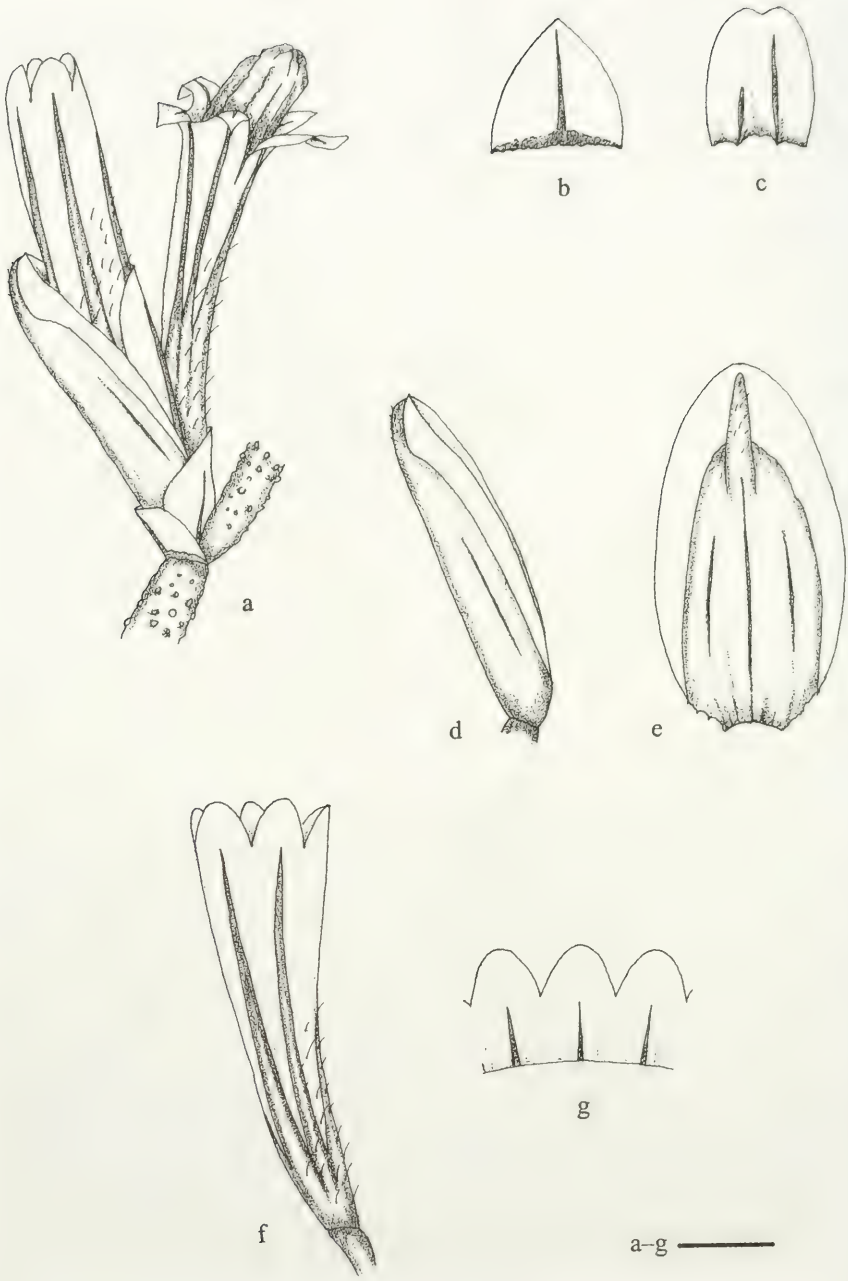

Abb. 4: a: Ährchen; b: äußere Braktee; c: mittlere Braktee; d: innere Braktee (Seitenansicht); e: innere Braktee (Rückenansicht); f: Kelch; g: Kelchzähne. Maßstab: 1 mm.

Diese neue Sippe tritt nur im Gebiet der Kalkhänge am Capo S. Elia auf. Das Epitheton „caralitanum" leitet sich von der römischen Bezeichnung „caralitanum promontorium" für dieses Kap ab. Ohne Zweifel ist *Limonium caralitanum* in den Formenkreis von *L. retirameum* sensu Arrigoni zu stellen, der durch seine zierlichen, stark verzweigten Stengel und Äste sowie durch seine zarten Ährchen charakterisiert ist. Besonders auffallend bei *L. caralitanum* sind seine zylinder- bis kegelförmigen Infloreszenzen, die durch allseitswendig angeordnete Äste hervorgerufen werden und die im stumpfen Winkel abzweigenden Äste und Ästchen. Alle übrigen sardischen Arten besitzen infolge ein- oder zweiseitswendig angeordneter Äste nur flache Blütenstände und ihre Äste zweigen in einem spitzen Winkel ab.

Untersuchte Aufsammlungen:

Sardinien. Prov. Cagliari: Meernahe Kalkhänge bei Poetto, 10–50 m; 9.–20.4.1966, *Merxmüller 21066 & Oberwinkler* (M) – Südöstlich von Cagliari, Felsküste in der Umgebung des Faro S. Elia, 3.10.1979, *Erben E 325* (Li-622) (M, MSB, Herb. Erben) – Südöstlich von Cagliari, Felsküste zwischen der Cala Mosca und dem Capo S. Elia, 3.10.1979, *Erben E 327* (Li-624) (MSB, Herb. Erben) – Cagliari, Felsküste südlich S. Elia, 9.9.1992, *Erben E 947* (MSB, Herb. Erben) – Südöstlich von Cagliari, Capo S. Elia, Kalkhänge an der Cala Mosca, ca. 10 m, 14.6.1996, *Erben E 1000* (Herb. Erben) – Südöstlich von Cagliari, Felsküste am Capo S. Elia, Kalkgestein, 10–25 m; 39°11' N – 09°09' E, 16.9.2000, *Erben E 1144* (MSB, Herb. Erben).

Es wäre schon verwunderlich, wenn *Limonium caralitanum* nicht auch Bastarde mit angrenzenden Sippen bilden würde und so findet man am Rande der Kalkhänge sowohl Bastardformen mit *L. tigulianum* als auch mit *L. dubium*.

Limonium caralitanum Erben x ***L. tigulianum*** Arrigoni & Diana

Dieser Bastard ist an seinen nahezu flachen Infloreszenzen, den nicht mehr im stumpfen Winkel abzweigenden Ästen und Ästchen, den meist viel längeren Ähren und den weiter auseinander stehenden Ährchen leicht zu erkennen. Daneben treten aber auch Rückkreuzungsformen auf, die sich habituell den Elternsippen nähern. Als Chromosomenzahl wurde 2n = 18 ermittelt.

Limonium caralitanum Erben x ***L. dubium*** (Andr. ex. Guss.) Litard.

Hybridpflanzen dieser Kombination ähneln im Habitus eher *Limonium caralitanum*. Von typischen Exemplaren dieser Art unterscheiden sie sich aber durch weniger stark verzweigte Äste, längere und meist geschweifte Ähren sowie durch reicherblütige Ährchen. Auch für sie wurde die Chromosomenzahl 2n = 18 ermittelt.

3. ***Limonium multifurcatum*** Erben, spec. nov.

Holotypus: Sardinien, Prov. Sassari: ca. 1 km westlich von Porto Cervo, feucht-sandige Flächen an der Mündung eines kleinen Flusses ins Meer, 25.8.1973, *Erben E 67* (MSB 85577; Isotypen: FI, Herb. Erben)

Abb.: 5–6

Planta perennis, glabra, pluricaulis. Caudiculi 5–15 cm longi, in parte superiore ramosi et laxe spiraliter foliosi. Folia basalia in partibus 2/3 inferioribus caudiculorum emarcida, solo in parte 1/3 superiore persistentia, 20–40 mm longa et 2–3 mm lata, lineari- ad angustissime spatulata, rotunda ad obtusa, in sectione transversali carinata, 1-nervia, subrevoluta, apice uncinata, supra dense verrucosa. Caules erecti, (15–)25–40(–60) cm longi, subflexuosi, circiter a

basi ramosi. Rami solo in parte 1/4 superiore caulis fertiles, distiche dispositi, plerumque ab imo ad summum brevioresccentes vel interdum rami subaequilongi, laxe ramosi, 1–4 cm longi, solo interdum 2–4 inferiores usque ad 12 cm longi, oblique sursum spectantes, sub angulis 30°–40° abeuntes, rami breviores non ramosi, longiores laxe ramosi; ramuli brevissimi, plerumque secunde oblique sursum spectantes, furcate ramosi. Inflorescentia racemosa, forma anguste trullata. Spicae solo in parte 1/4 superiore inflorescentiae dispositae, 5–25(–60) mm longae, subrectae. Spiculae cetero spicae terminalis secunde sursum spectantes, 6–7 mm longae, 1–2-florae, ad (1–)3–4 in 1 centimetro dispositae, non vel solo partim mutue attingentes. Bractea inferior 1,3–1,7 mm longa et 1,6–1,8 mm lata, triangulari-ovata, acuta, margine late membranaceo, parte centrali subcarnosula, acuminata, acumine marginem fere contingente. Bractea media membranacea, 1,6–2,0 mm longa et 1,6–1,9 mm lata, late oblongo-elliptica, rotunda vel asymmetrice biloba. Bractea superior dorso longitudinaliter plus minusve arcuata, 4,3–5,1 mm longa et 2,2–2,8 mm lata, elliptica ad oblongo-elliptica, obtusa, margine anguste membranaceo, parte centrali carnosa, 3,4–4,2 mm longa et 1,4–2,1 mm lata, oblonga, acuminata, acumine 0,9–1,0 mm longo marginem fere contingente. Calyx 4,9–5,9 mm longus, ex bractea superiore 1,7–2,2 mm exsertus, tubo imprimis unilateraliter sparsim breviter piloso; dentes calycis ca. 0,8 × 1,0 mm, semi-elliptici; costae tubi ad basim dentium calycis desinentes; calyx florae secundae usque ad 1,1 mm pedunculatus et lateraliter exstans. Petala 8,7–8,9 mm longa et 2,7–2,9 mm lata, cuneata, emarginata, caeruleo-violacea. Corolla infundibuliformis, diametro 6,8–7,3 mm. Chromosomatum numerus: 2n = 18.

Pflanze ausdauernd, kahl, mehrstengelig. Stämmchen 5–15 cm lang, am oberen Ende verzweigt, locker schraubig beblättert. Blätter in den unteren 2/3 der Stämmchen verwelkt und nur im oberen Drittel grün, 20–40 mm lang und 2–3 mm breit, lineal- bis sehr schmal spatelförmig, am oberen Ende rund bis stumpf, zur Basis hin sich wieder langsam verbreiternd, im Querschnitt schwach v-förmig, 1-nervig, an den Rändern und an der Spitze leicht nach unten gebogen, oberseits dicht mit kraterförmigen Drüsen besetzt. Stengel aufrecht, (15–)25–40 (–60) cm lang, schwach zickzackförmig gebogen, nahezu von der Basis an verzweigt. Äste 1. Ordnung nur im oberen Viertel fertil, zweiseitswendig angeordnet, meist von unten nach oben kürzer werdend oder bisweilen auch alle Äste nahezu gleich lang, locker verzweigt, 1–4 cm lang, nur gelegentlich die unteren 2–4 bis zu 12 cm lang, schräg nach oben gerichtet (Verzweigungswinkel 30°–40°), kürzere Äste unverzweigt, längere locker verzweigt. Äste 2. Ordnung sehr kurz, meist einseitswendig nach oben gerichtet und gabelartig verzweigt. Infloreszenz traubenförmig, im Umriss schmal trullat. Ähren nur im oberen Viertel der Infloreszenz sitzend, 5–25(–60) mm lang, nahezu gerade. Ährchen mit Ausnahme derjenigen der Endähre einseitswendig nach oben gerichtet, 6–7 mm lang, 1–2-blütig, zu (1–)3–4 pro Zentimeter angeordnet, sich nicht oder nur teilweise berührend. Äußere Braktee 1,3–1,7 mm lang und 1,6–1,8 mm breit, dreieckig-eiförmig, am oberen Ende spitz; Rand breit häutig; zentraler Bereich nur etwas fleischig, mit einer fast bis zum Rand reichenden Spitze. Mittlere Braktee häutig, 1,6–2,0 mm lang und 1,6–1,9 mm breit, breit länglich-elliptisch, am oberen Ende rund oder asymmetrisch zweilappig. Innere Braktee am Rücken in Längsrichtung mehr oder weniger bogenförmig gekrümmt, 4,3–5,1 mm lang und 2,2–2,8 mm breit, elliptisch bis länglich-elliptisch, am oberen Ende stumpf; Rand schmal weißhäutig; zentraler Bereich fleischig, 3,2–4,2 mm lang und 1,4–2,1 mm breit, länglich, mit einer 0,9–1,0 mm langen, fast bis zum Rand reichenden Spitze. Kelch 4,9–5,9 mm lang, die innere Braktee um 1,7–2,2 mm überragend; Kelchröhre vor allem auf einer Hälfte in Basisnähe spärlich kurz behaart; Kelchzähne ca. 0,8 × 1,0 mm, halbelliptisch; Rippen der Kelchröhre an der Kelchzahnbasis auslaufend; Kelch der 2. Blüte bis zu 1,1 mm lang gestielt und seitlich abstehend. Kronblätter 8,7–8,9 mm lang und 2,7–2,9 mm breit, keilförmig, am oberen Ende ausgerandet, blau-violett. Blütendurchmesser 6,8–7,3 mm. Chromosomenzahl: 2n = 18; untersucht wurden Exemplare der Aufsammlungen Li-225 und Li-305.

Abb. 5: *Limonium multifurcatum* Erben

Abb. 6: a: Ähre; b: äußere Braktee; c: mittlere Braktee; d: innere Braktee (Seitenansicht); e: innere Braktee (Rückenansicht); f: Kelch; g: Kelchzähne; h: Kronblatt. Maßstab: 1 mm.

Wie viele sardische Arten der Gattung *Limonium* besitzt auch *L. multifurcatum* nur ein punktförmiges Areal an der Costa Smeralda in der Nähe von Porto Cervo. Sie wächst dort auf etwas erhöhten, feucht-sandigen Stellen im Mündungsdelta eines Baches ins Meer.

Der nähere systematische Anschluss ist aufgrund ihrer Chromosomenzahl 2n = 18 nicht leicht zu bestimmen, obwohl diese Zahl nur relativ wenige sardische Sippen aufweisen. Habituell ähnelt sie in groben Zügen *L. racemosum* (Lojac.) Diana, einer ebenfalls diploiden Art, die das miozänische Kalkplateau in der Umgebung von Sassari besiedelt. Es ist aber unwahrscheinlich, dass *L. multifurcatum* wirklich nähere Beziehungen zu dieser alten Sippe haben sollte. Einige morphologischen Merkmale und auch die karyologischen Daten lassen eher die Vermutung zu, dass diese Art durch Hybridisierung der diploiden Art *L. protohermaeum* Arrigoni & Diana mit der ebenfalls diploiden *L. pulviniforme* Arrigoni & Diana entstanden sein könnte. Auf das ca. 150 km weiter im Süden vorkommende *L. protohermaeum* weisen ihre sehr schmalen Blätter, auf die ca. 30 km weiter im Norden wachsende *L. pulviniforme* deuten dagegen die im stumpfen Winkel abzweigenden Ästchen.

Durch ihre sehr schmalen, spatelförmigen Blätter und ihre langen, extrem schmalen Infloreszenzen sowie durch die für sie charakteristische, gabelartige Anordnung der Ästchen bestehen keine Verwechslungsmöglichkeiten mit anderen sardischen Sippen.

Untersuchte Aufsammlungen:

Sardinien. Prov. Sassari: Ca.1 km westlich von Porto Cervo, feucht-sandige Flächen an der Mündung eines kleinen Flusses ins Meer, 25.8.1973, *Erben E 67* (Li-225) (FI, MSB, Herb. Erben) – Nordöstlich von Arzachena, Porto Cervo, an einer Bachmündung kurz vor Liscia di Vacca, 23.8.1974, *Erben E 117* (Li-305) (Herb. Erben).

4. ***Limonium capitis-eliae*** Erben, spec. nov.

Holotypus: Sardinien, Prov. Cagliari: Südöstlich von Cagliari, am Rand der Staubstraße zum Capo S. Elia, auf Kalksteinfelsen und sandigen Flächen, 10–25 m; 39°11' N – 09°09' E, 16.9.2000, *Erben E 1145* (MSB 85590; Isotypen: FI, Herb. Erben).

Abb.: 7–8

Planta perennis, partim breviter papilloso-pilosa, oligocaulis. Caudiculi 1–5-cm longi, in parte superiore laxe ramosi. Folia florendi tempore non vel solo partim emarcida, laxe rosulata, griseo-viridia, 25–110 mm longa et 3–8 mm lata, anguste oblanceolata, acuta ad obtusa, interdum mucronata, subtus nervis 3–5 partim pinnatim abeuntibus, in petiolum longitudinem laminae omnino vel fere omnino attingentem 1–3 mm latum tarde attenuata. Caules 25–50 cm longi, erecti, subflexuosi, saepe in parte inferiore breviter papilloso-pilosi, fere a basi ramosi. Rami laxe distiche dispositi, in partibus 2/3 inferioribus caulis steriles, 2–10 cm longi, non vel laxe ramosi, in parte 1/3 superiore caulis fertiles, 5–16 cm longi, oblique sursum spectantes, sub angulis 30°–40° abeuntes, laxe ramosi; ramuli plerumque secunde sursum spectantes. Inflorescentia paniculata, plana, forma anguste ad late obtrullata. Spicae dense, interdum glomerate in finibus ramorum dispositae, 5–25 mm longae, subrectae. Spiculae 5–6 mm longae, 1–3-florae, dense ad (4–)6–7 in 1 centimetro dispositae, mutue attingentes. Bractea inferior tenuissima, 1,7–1,8 mm longa et 1,6–1,9 mm lata, triangulari-ovata, acuta ad obtusa, parte centrali plus minusve membranacea, acuminata, acumine inconspicuo marginem fere contingente. Bractea media 1,6–1,9 mm longa et 1,1–1,3 mm lata, fere rectangularis, rotunda ad asymmetrice biloba, costa longiore marginem fere attingente. Bractea superior 3,9–4,2 mm longa et 2,6–2,9 mm lata, elliptica, obtusa ad rotunda, dorso longitudinaliter subarcuata, solo in parte 1/4 superiore magis inflexa, parte centrali 2,8–3,1 mm longa et 1,5–1,8 mm lata, oblongo-elliptica, acuminata, acumine 1,0–1,3 mm longo, marginem fere contingente. Calyx 4,0–4,7 mm longus, ex bractea superiore 0,9–1,3 mm exsertus, tubo imprimis unilateraliter

sparsim longe piloso; dentes calycis ca. 0,7 × 1,0 mm, late semi-elliptici; costae tubi ad basim dentium calycis desinentes. Corolla rubro-violacea, diametro 6,5–7,5 mm. Chromosomatum numerus: 2n = 27.

Pflanze ausdauernd, teilweise kurz papillös behaart, wenigstengelig. Stämmchen 1–5 cm lang, am oberen Ende locker verzweigt. Blätter zur Blütezeit nicht oder nur teilweise verwelkt, locker rosettig angeordnet, graugrün, je nach Standort 25–110 mm lang und 3–8 mm breit; Spreite schmal oblanzeolat, am oberen Ende spitz bis stumpf, bisweilen mit einem kleinen Spitzchen versehen, mit einem auf der Unterseite deutlich sichtbaren Hauptnerv und 2–4 feinen, teilweise fiederartig abzweigenden Seitennerven, allmählich in einen 1–3 mm breiten, zur Basis hin sich wieder allmählich verbreiternden Stiel übergehend; Stiel so lang oder etwas kürzer als die Spreite. Stengel 25–50 cm lang, aufrecht, schwach zickzackförmig gebogen, häufig in der unteren Hälfte kurz papillös behaart, fast von der Basis an verzweigt. Äste lokker zweiseitswendig angeordnet, in den unteren zwei Dritteln des Stengels steril, 2–10 cm lang, nicht oder nur locker verzweigt, im oberen Drittel des Stengels fertil, 5–16 cm lang, schräg nach oben gerichtet (Verzweigungswinkel 30°–40°), locker verzweigt; Ästchen meist einseitswendig nach oben gerichtet. Infloreszenz rispenartig, flach, im Umriss schmal bis breit obtrullat. Ähren dicht, bisweilen auch knäuelartig an den Enden der Äste sitzend, 5–25 mm lang, nahezu gerade. Ährchen 5–6 mm lang, 1–3-blütig, dicht stehend zu (4–)6–7 pro Zentimeter, sich gegenseitig berührend. Äußere Braktee sehr zart, von der Ährenachse deutlich abgesetzt, 1,7–1,8 mm lang und 1,6–1,9 mm breit, dreieckig-eiförmig, am oberen Ende spitz bis stumpf; zentraler Bereich mehr oder weniger häutig, mit einer nur angedeuteten, fast bis zum Rand reichenden Spitze. Mittlere Braktee 1,6–1,9 mm lang und 1,1–1,3 mm breit, nahezu rechteckig, am oberen Ende rund bis asymmetrisch zweilappig; längere Rippe fast bis zum oberen Rand reichend. Innere Braktee 3,9–4,2 mm lang und 2,6–2,9 mm breit, elliptisch, am oberen Ende stumpf bis rund, am Rücken in Längsrichtung schwach bogenförmig, nur im oberen Viertel stärker nach innen gebogen; zentraler Bereich 2,8–3,1 mm lang und 1,5–1,8 mm breit, länglich-elliptisch, mit einer 1,0–1,3 mm langen, fast bis zum Rand reichenden Spitze. Kelch 4,0–4,7 mm lang, die innere Braktee um 0,9–1,3 mm überragend, Kelchröhre vor allem auf einer Hälfte spärlich lang behaart; Kelchzähne ca. 0,7 × 1,0 mm, breit halbelliptisch; Rippen der Kelchröhre an der Kelchzahnbasis auslaufend. Blüten rot-violett, mit einem Durchmesser von 6,5–7,5 mm. Chromosomenzahl: 2n = 27; untersucht wurden Exemplare der Aufsammlungen Li-625 und Li-1560.

Limonium capitis-eliae besitzt ein isoliertes Vorkommen am Capo S. Elia südöstlich von Cagliari. Sie wächst dort ausschließlich – wie auch *L. caralitanum* – auf kalkhaltigem Untergrund.

L. capitis-eliae ist hinsichtlich ihrer morphologischen Merkmale sowie karyologischen Daten nicht mit letzter Sicherheit einem bestimmten Formenkreis zuzuordnen. Eine gewisse habituelle Ähnlichkeit besteht zu *L. dubium* (Guss.) R.Litard., *L. virgatum* (Willd.) Fourr. als auch zu *L. glomeratum* (Tausch) Erben. Von *L. dubium* ist es durch seine größeren und zur Blütezeit nicht verwelkten Blätter, die nur locker verzweigten Stengel und die kleineren Ährchen gut zu trennen. *L. virgatum* besitzt zwar einen ähnlichen Verzweigungstyp, zeichnet sich aber vor allem durch viel längere Ähren und größere, deutlich seitlich eingekrümmte Ährchen aus. *L. glomeratum* ist schließlich durch seine völlige Kahlheit, seine im Verhältnis zur Länge breiteren Blätter, seine dichter angeordneten Ährchen sowie durch seine längeren Brakteen und Kelche hinreichend charakterisiert.

Abb. 7: *Limonium capitis-eliae* Erben

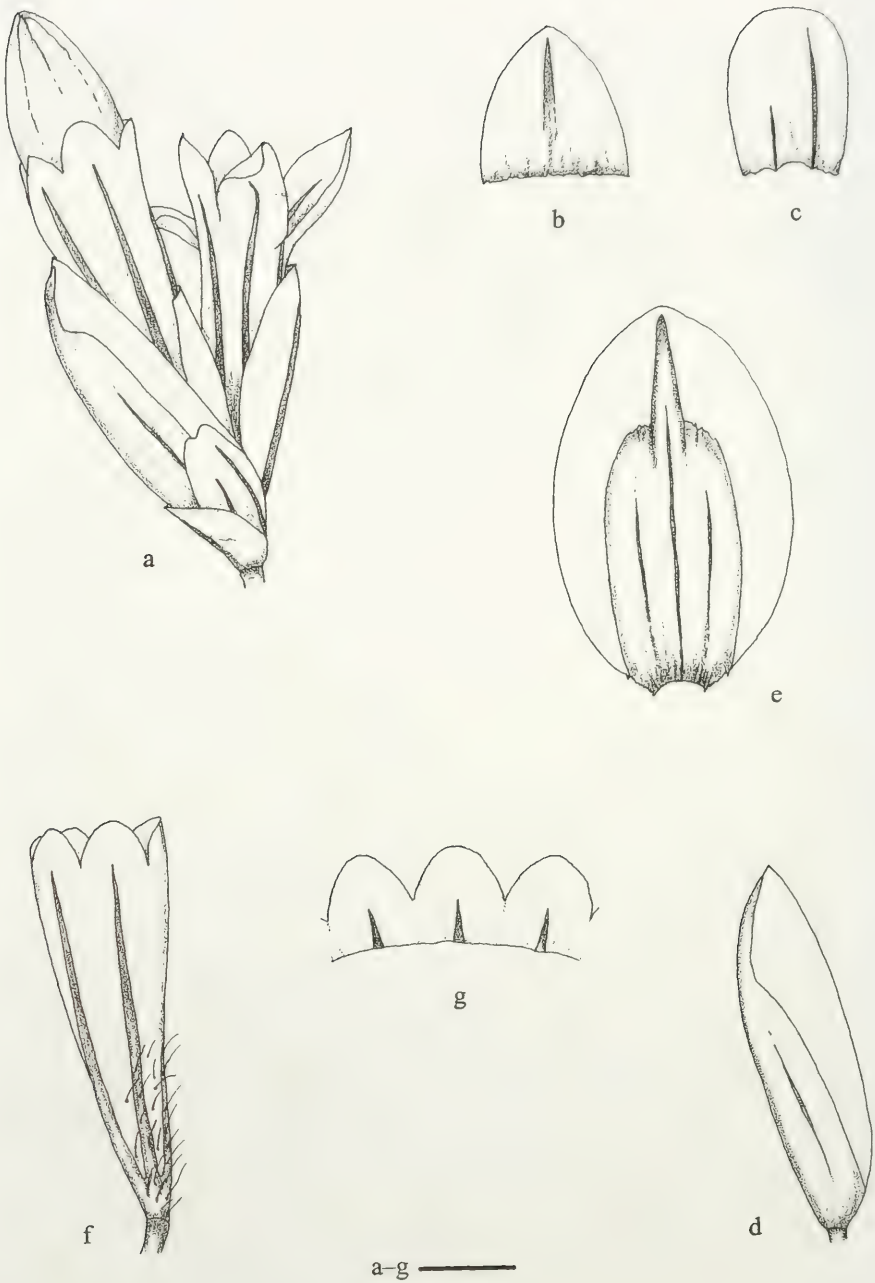

Abb. 8: a: Ährchen; b: äußere Braktee; c: mittlere Braktee; d: innere Braktee (Seitenansicht); e: innere Braktee (Rückenansicht); f: Kelch; g: Kelchzähne. Maßstab: 1 mm.

Untersuchte Aufsammlungen:

Sardinien. Prov. Cagliari: In maritimis prope Cagliari, Julio, *Müller* (sub *Statice virgata*) (M) – Südöstlich von Cagliari, Felsküste zwischen der Cala Mosca und dem Capo S. Elia, Kalkgestein, 20–30 m, 3.10.1979, *Erben E 328* (Li-625) (Herb. Erben) – Südöstlich von Cagliari, Felsküste am Capo S. Elia, Kalkgestein, 25–50 m, 29.6.2000, *Erben E 1132* (Herb. Erben) – Südöstlich von Cagliari, am Rand der Staubstraße zum Capo S. Elia, auf Kalksteinfelsen und sandigen Flächen, 10–15 m, 39°11' N – 09°09' E, 16.9.2000, *Erben E 1145* (Li-1560) (FI, MSB, Herb. Erben).

5. ***Limonium malfatanicum*** Erben, spec. nov.

Holotypus: Sardinien, Prov. Cagliari: Südöstlich von Teulada, Porto di Malfatano, Sandflächen am nördlichen Ufer des Stagno, 1–5 m, 38°54' N – 08°48' E, 13.9.2000, *Erben E 1140* (MSB 85566; Isotypen: FI, Herb. Erben).

Abb.: 9–10

Planta perennis, partim brevissime papilloso-pilosa, multicaulis, frutex densa formans. Caudiculi 1–7(–10) cm longi, in parte superiore dense ramosi. Folia plerumque florendi tempore omnino emarcida, dense rosulata, atro-viridia, 10–65 mm longa et 3–6(–12) mm lata, anguste spatulata, obtusa ad acuta, frequenter cuspidata, nervis lateralibus 2–4 partim pinnatim abeuntibus, subtus stomatiis excavato-punctata, in petiolum 1–3 mm latum, lamina aliquantum breviorem sensim attenuata. Caules 15–40 cm longi, tenues, erecti ad adscendentes, subflexuosi, in parte inferiore brevissime papilloso-pilosi, plus minusve a basi dense ad densissime ramosi. Rami caulium adscendentium secunde dispositi, rami caulium erectorum distiche dispositi, in dimidio inferiore vel in partibus 2/3 inferioribus caulium steriles, 1,5–10 cm longi, laxe ad dense ramosi, in dimidio superiore vel in parte 1/3 superiore caulium fertiles, 5–20 cm longi, dense ad densissime ramosi, oblique sursum spectantes ad adscendentes, sub angulis 30°–50° abeuntes. Inflorescentia paniculata, plana, forma obtrullata. Spicae dense dispositae, 10–40 mm longae, rectae ad subarcuatae, oblique sursum spectantes ad erectae. Spiculae 5,5–6,5 mm longae, 1–3-florae, ad basim spicarum laxe ad 2–3 in 1 centimetro, ad finem spicarum densius ad 4–5 in 1 centimetro dispositae, non vel solo partim mutue attingentes. Bractea inferior tenuis, 1,2–1,7 mm longa et 1,5–1,8 mm lata, triangulari-ovata, acuta ad obtusa, parte centrali plus minusve membranacea, atro-fusca, solo ad basim carnosula, acuminata, acumine marginem fere contingente. Bractea media 1,6–2,0 mm longa et 1,1–1,3 mm lata, oblongo-elliptica, rotunda, costis 2 subaequilongis marginem non contingentibus. Bractea superior 4,0–4,5 mm longa et 2,6–3,0 mm lata, elliptica, acuta ad obtusa, dorso longitudinaliter plus minusve arcuata, in parte 1/4 superiore magis inflexa, margine late membranaceo, parte centrali 2,7–3,2 mm longa et 1,8–2,0 mm lata, oblongo-ovata, acuminata, acumine 1,0–1,2 mm longo marginem fere contingente. Calyx 4,2–4,6 mm longus, ex bractea superiore 1,2–1,8 mm exsertus, tubo imprimis unilateraliter sparse ad dense, plus minusve longe piloso; dentes calycis ca. 0,7 × 0,9 mm, semi-elliptici; costae tubi breviter supra basim dentium calycis desinentes. Corolla caeruleo-violacea, diametro 6,5–7,5 mm. Chromosomatum numerus: 2n = 27.

Pflanze ausdauernd, teilweise sehr kurz papillös behaart, vielstengelig, einen dichten Busch bildend. Stämmchen 1–7(–10) cm lang, am oberen Ende dicht verzweigt. Blätter zur Blütezeit meist schon völlig verwelkt, dicht rosettig angeordnet, dunkelgrün, 10–65 mm lang und 3–6(–12) mm breit; Spreite schmal spatelförmig, am oberen Ende stumpf bis spitz, häufig mit einem ca. 1 mm langen, nach unten gebogenen Spitzchen, mit einem deutlich sichtbaren Hauptnerv und 2–4 fiederartig abzweigenden Seitennerven, unterseits durch kraterförmig eingesenkte Spaltöffnungen punktiert, allmählich in den Stiel übergehend; Stiel 1–3 mm breit, etwas kürzer als die Spreite. Stengel 15–40 cm lang, zart, aufrecht bis aufsteigend, schwach

zickzackförmig gebogen, in der unteren Hälfte sehr kurz papillös behaart, mehr oder weniger von der Basis an dicht bis sehr dicht verzweigt. Äste an aufsteigenden Stengeln einseitswendig, an aufrechten zweiseitswendig angeordnet, in der unteren Hälfte bis in den unteren zwei Dritteln des Stengels steril, 1,5–10 cm lang, locker bis dicht verzweigt, in der oberen Hälfte bzw. im oberen Drittel des Stengels fertil, 5–20 cm lang, dicht bis sehr dicht verzweigt, schräg nach oben gerichtet bis aufsteigend (Verzweigungswinkel 30°–50°). Infloreszenz rispenartig, flach, im Umriss obtrullat. Ähren dicht angeordnet, 10–40 mm lang, gerade bis schwach bogenförmig, schräg nach oben gerichtet bis aufrecht. Ährchen 5,5–6,5 mm lang, 1–3-blütig, an der Basis der Ähren locker angeordnet zu 2–3 pro Zentimeter, zur Spitze hin dichter mit 4–5 pro Zentimeter, sich gegenseitig nicht oder nur teilweise berührend. Äußere Braktee zart, 1,2–1,7 mm lang und 1,5–1,8 mm breit, dreieckig-eiförmig, am oberen Ende spitz bis stumpf; zentraler Bereich mehr oder weniger häutig, dunkelbraun, nur an der Basis etwas fleischig, mit einer fast bis zum Rand reichenden Spitze. Mittlere Braktee 1,6–2,0 mm lang und 1,1–1,3 mm breit, länglich-elliptisch, am oberen Ende rund, mit zwei nahezu gleichlangen, nicht bis zum Rand reichenden Rippen. Innere Braktee 4,0–4,5 mm lang und 2,6–3,0 mm breit, elliptisch, am oberen Ende spitz bis stumpf, am Rücken in Längsrichtung mehr oder weniger bogenförmig gekrümmt, im oberen Viertel deutlich stärker nach innen gekrümmt; Rand breit weißhäutig; zentraler Bereich 2,7–3,2 mm lang und 1,8–2,0 mm breit, länglich-eiförmig, mit einer 1,0–1,2 mm langen, fast bis zum Rand reichenden Spitze. Kelch 4,2–4,6 mm lang, die innere Braktee um 1,2–1,8 mm überragend, Kelchröhre vor allem auf einer Hälfte spärlich bis dicht, mehr oder weniger lang behaart; Kelchzähne ca. 0,7 × 0,9 mm, halbelliptisch; Rippen der Kelchröhre kurz über der Kelchzahnbasis auslaufend. Blüten blauviolett, mit einem Durchmesser von 6,5–7,5 mm. Chromosomenzahl: 2n = 27; untersucht wurden Exemplare der Aufsammlungen Li-651, Li-1319, Li-1397, Li-1497 und Li-1511.

Diese neue Art ist mir schon seit vielen Jahren bekannt, aber erst im letzten Jahr hatte ich die Gelegenheit, *Limonium malfatanicum* am Originalstandort in voller Blüte zu studieren und zu sammeln. Ihr punktförmiges, nur wenige hundert Meter langes Areal erstreckt sich am nördlichen Ufer des Stagno di Malfatano. Sie bildet dort in unmittelbarer Nähe des Meeres auf sandigem Boden dichte Bestände, die aus Hunderten von gleichaussehenden Pflanzen bestehen.

Im Blütenbereich ist sie *L. capitis-eliae* Erben sehr ähnlich, zeigt aber habituell durch ihr dichtes Astwerk einen völlig anderen Aspekt und erinnert damit eher an *L. duriusculum* (Girard) Fourr., eine Art, die an der Küste Süd-Frankreichs und Nord-Spaniens beheimatet ist und die sich durch deutlich längere Ähren und größere Ährchen auszeichnet. Ihr völlig anderes Aussehen und ihre unterschiedlichen ökologischen Ansprüche rechtfertigen meiner Meinung nach, *L. malfatanicum* den Status einer eigenen Art zu zuerkennen.

Untersuchte Aufsammlungen:

Sardinien. Prov. Cagliari: Capo Malfatano, Sandstrand beim Hafen, 1–5 m, 7.10.1979, *Erben E 354* (Li-651) (Herb. Erben) – Capo Malfatano, 8,6 km südwestlich der Abzweigung zum Torre di Chia, Sandstrand, 2–5 m, 3.6.1991, *Erben E 880* (Li-1397) (Herb. Erben) – Stagno am Weg zum Capo Malfatano, Sandschlickboden, 0–1 m, 38°54' N – 08°48' E, 15.6.1996, *Erben E 1004* (Li-1397) (Herb. Erben) – Südküste, Stagno beim Porto di Malfatano, Sandschlickboden, 15.6.1998, *Erben E 1076* (Li-1497) (Herb. Erben) – Im Uferbereich des Stagno am Porto di Malfatano, Sandschlickboden, 0–3 m, 3.6.1999, *Erben E 1079* (Li-1511) (Herb. Erben) – Südöstlich von Teulada, Porto di Malfatano, 0–4 m, 22.6.2000, *Erben E 1116* (Herb. Erben) – Südöstlich von Teulada, Porto di Malfatano, Sandflächen am nördlichen Ufer des Stagno, 1–5 m, 38°54' N – 08°48' E, 13.9.2000, *Erben E 1140* (FI, MSB, Herb. Erben).

Abb. 9: *Limonium malfatanicum* Erben

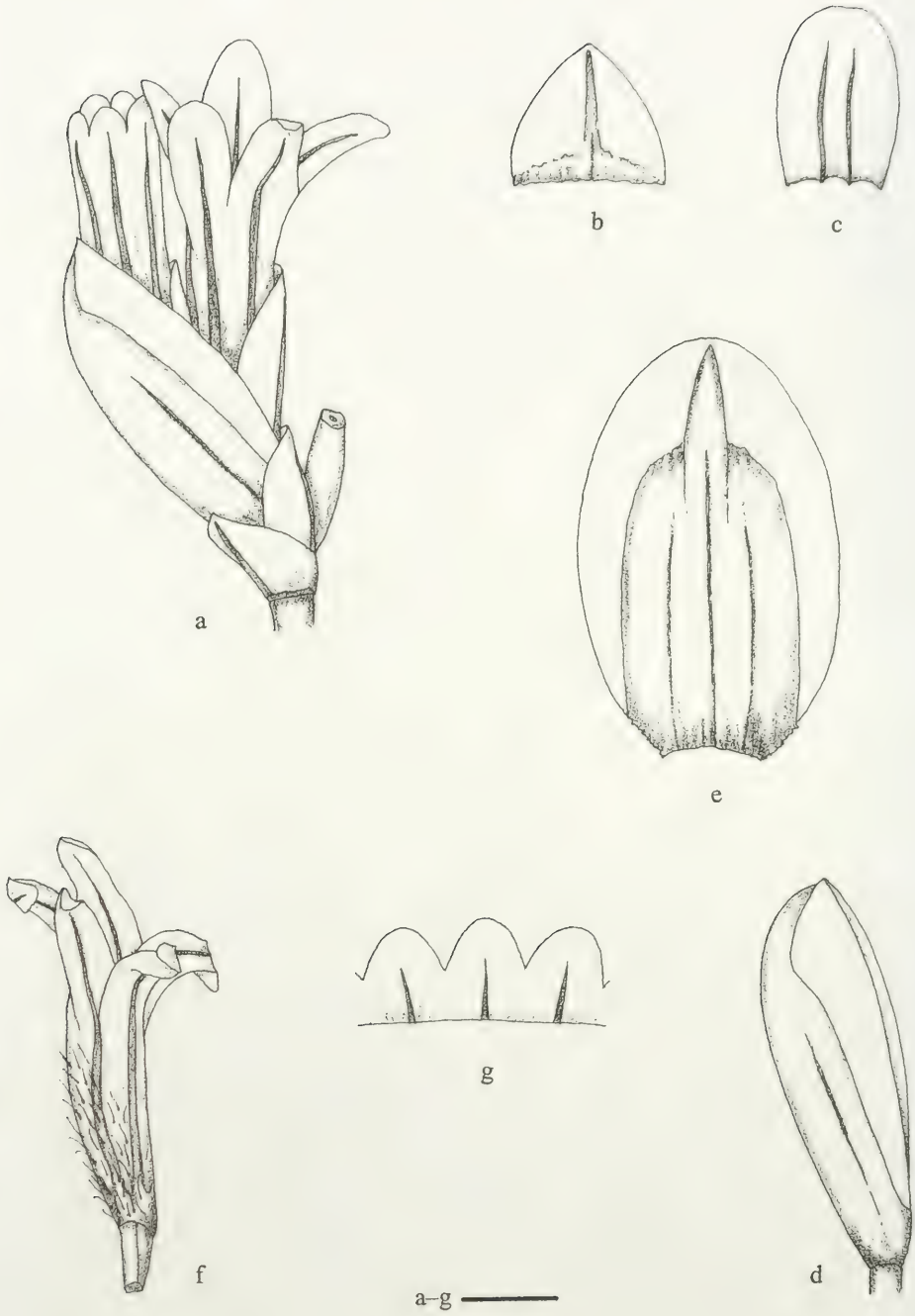

Abb. 10: a: Ährchen; b: äußere Braktee; c: mittlere Braktee; d: innere Braktee (Seitenansicht); e: innere Braktee (Rückenansicht); f: Kelch; g: Kelchzähne. Maßstab: 1 mm.

6. ***Limonium carisae*** Erben, spec. nov.
Holotypus: Sardinien, Prov. Cagliari: Südlich von Cagliari, Pula, am südwestlichen Damm der Peschiera di Nora, der die Fischzucht-Becken vom Meer trennt, auf sandig-lehmigem Boden, 0–1 m; 38°59' N – 09°00' E, 12.9.2000, *Erben E 1137* (MSB 85580; Isotypen: Herb. Erben)

Abb.: 11–12

Planta perennis, valida, glabra, oligocaulis. Caudiculi 2–3 cm longi, in parte superiore laxe ramosi. Folia rosulata, florendi tempore partim emarcida, intra rosulam aliter longa, 20–80 mm longa et 2–10 mm lata, oblanceolata ad anguste spatulata, acuta ad obtusa, subplana, subtus 1-nervia, in petiolum 2–3 mm latum circiter 2/3 longitudinis laminae attingentem sensim attenuata. Caules validi, glabri, 20–40 cm longi, subflexuosi, fere a basi ramosi. Rami distiche dichotomiforme dispositi, in dimidio inferiore vel in partibus 2/3 inferioribus caulium steriles, in dimidio superiore vel in parte 1/3 superiore caulium fertiles, 2–7 cm longi, recti ad subarcuati, subarticulati, oblique sursum spectantes, sub angulis 40°–70° abeuntes, generaliter laxe secunde ramosi; ramuli breves, erecti, non vel laxe ramosi. Inflorescentia paniculata, plana, forma obtrullata ad cuneata. Spicae validae, post florendi tempus rubro-fuscae,10–40(–50) mm longae, rectae vel solo subarcuatae, oblique sursum spectantes. Spiculae praeter spiculam terminalem secunde sursum spectantes, 7–8 mm longae, 2–3(–5)-florae, ad 4–6 in 1 centimetro dispositae, saltem partim mutue attingentes. Bractea inferior submembranacea, 1,9–2,1 mm longa et 1,9–2,1 mm lata, triangulari-ovata, acuta, margine latissime membranacea, parte centrali solo subcarnosula, acuminata, acumine marginem non attingente. Bractea media membranacea, 2,0–2,3 mm longa et 1,9–2,1 mm lata, oblongo-elliptica, rotundata vel subemarginata. Bractea superior dorso longitudinaliter subrecta vel subarcuata, ad basim lateraliter non vel indistincte inflexa, 5,5–6,3 mm longa et 3,3–3,9 mm lata, oblongo-elliptica, obtusa, margine anguste membranacea, parte centrali carnosa, 4,2–5,0 mm longa et 2,2–2,7 mm lata, oblonga ad oblongo-elliptica, acuminata, acumine crasso, obtuso, 0,8–1,0 mm longo, marginem non attingente. Calyx florendi tempore anguste infundibuliformis, 5,7–6,3 mm longus, ex bractea superiore circiter 1,5 mm exsertus, tubo imprimis unilateraliter sparsim plus minusve longe piloso; dentes calycis ca. 0,5 × 1,0 mm, late semi-elliptici; costae tubi ad vel supra basim dentium calycis desinentes. Corolla caeruleo-violacea, diametro 7,5–8,5 mm. Chromosomatum numerus: 2n = 27.

Pflanze ausdauernd, robust, kahl, wenigstengelig. Stämmchen 2–3 cm lang, am oberen Ende locker verzweigt. Blätter rosettig angeordnet, zur Blütezeit teilweise verwelkt, innerhalb einer Rosette verschieden groß, 20–80 mm lang und 2–10 mm breit, oblanzeolat bis schmal spatelförmig, am oberen Ende spitz bis stumpf, nahezu eben, mit einem auf der Unterseite deutlich sichtbaren Hauptnerv, allmählich in einen 2–3 mm breiten, ungefähr 2/3 der Spreitenlänge erreichenden Stiel übergehend. Stengel kräftig, glatt, 20–40 cm lang, aufrecht, schwach zickzackförmig gebogen, fast von der Basis an verzweigt. Äste zweiseitswendig, dichotomartig vom Stengel abzweigend, in der unteren Hälfte bis in den unteren 2/3 der Stengel steril, in der oberen Hälfte bis im oberen Drittel fertil, 2–7 cm lang, gerade bis schwach bogenförmig, an den Knoten leicht eingeschnürt, schräg nach oben gerichtet bis ausgebreitet (Verzweigungswinkel 40°–70°), normalerweise locker, einseitswendig verzweigt; Ästchen kurz, aufrecht, nicht oder nur locker verzweigt. Infloreszenz rispenartig, flach, im Umriss obtrullat bis keilförmig. Ähren kompakt, sich nach der Blütezeit durch ihre rotbraune Farbe deutlich von den olivgrünen Ästen und Stengeln abhebend, 1–4(–5) cm lang, gerade oder nur schwach bogenförmig. Ährchen mit Ausnahme derjenigen der Endähren einseitswendig nach oben gerichtet, 7–8 mm lang, 2–3(–5)-blütig, zu 4–6 pro Zentimeter angeordnet, sich gegenseitig zumindest teilweise berührend. Äußere Braktee bis auf die Basis nahezu häutig, 1,9–2,1

mm lang und ebenso breit, dreieckig-eiförmig, am oberen Ende spitz; Rand breit weißhäutig; zentraler Bereich nahezu häutig, mit einer nicht bis zum Rand reichenden Spitze. Mittlere Braktee häutig, 2,0–2,3 mm lang und 1,9–2,1 mm breit, länglich-elliptisch, am oberen Ende abgerundet oder schwach ausgerandet. Innere Braktee am Rücken in Längsrichtung nahezu gerade bis schwach bogenförmig, an der Basis seitlich leicht eingekrümmt, 5,5–6,3 mm lang und 3,3–3,9 mm breit, länglich-elliptisch, am oberen Ende stumpf; Rand schmal weißhäutig; zentraler Bereich fleischig, 4,2–5,0 mm lang und 2,2–2,7 mm breit, länglich bis länglich-elliptisch, mit einer 0,8–1,0 mm langen, mehr oder weniger dickfleischigen, stumpfen, nicht bis zum Rand reichenden Spitze. Kelch zur Blütezeit schmal trichterförmig, 5,7–6,3 mm lang, die innere Braktee um ca. 1,5 mm überragend; Kelchröhre vor allem auf einer Hälfte spärlich, mehr oder weniger lang behaart; Kelchzähne sehr zart, ca. 0,5 × 1,0 mm, breit halbelliptisch; Rippen der Kelchröhre an oder kurz vor der Kelchzahnbasis auslaufend. Krone blauviolett, mit einem Durchmesser von 7,5–8,5 mm. Chromosomenzahl: 2n = 27; untersucht wurden Exemplare der Aufsammlung Li-1561.

Diese bisher nur in der Typusaufsammlung bekannte neue Art haben meine beiden Töchter Isabelle und Caroline mit mir auf einer Sammeltour gefunden. Sie erhält daher den Namen „carisa“, der aus den ersten Silben ihrer beiden Vornamen gebildet wurde.

Limonium carisae wächst südöstlich von Pula in großer Menge auf den Dämmen, die die Fischzucht-Becken gegeneinander bzw. vom Meer trennen. Neben *L. carisae*, das nahe am Wasserspiegel wächst, findet man dort etwas höher angesiedelt auch *L. virgatum* (Willd.) Fourr. und auf der Dammkrone *L. dubium* (Guss.) R.Litard.. Es ist anzunehmen, dass *L. carisae* durch Bastardierung dieser beiden Arten entstanden ist, obwohl beide Elternsippen im Vergleich zu *L. carisae* einen viel zierlicheren Wuchs aufweisen.

Habituell erinnert *Limonium carisae* noch am ehesten an *L. virgatum,* von der sie aber auf den ersten Blick durch ihren robusten Wuchs, die stärker verzweigten, starren Äste und die viel kompakteren Ähren zu unterscheiden ist. Außerdem sind ihre Ährchen an der Basis seitlich – wenn überhaupt – nur schwach eingekrümmt und der zentrale Bereich der inneren Braktee trägt im Gegensatz zu *L. virgatum* eine mehr oder weniger dickfleischige, stumpfe Spitze.

Untersuchte Aufsammlung:

Sardinien. Prov. Cagliari: Südlich von Cagliari, Pula, am südwestlichen Damm der Peschiera di Nora, der die Fischzucht-Becken vom Meer trennt, auf sandig-lehmigen Boden, 0–1 m; 38°59' N – 09°00' E, 12.9.2000, *Erben E 1137* (Li-1561) (MSB, Herb. Erben).

Limonium carisae Erben x ***Limonium virgatum*** (Willd.) Fourr.

Auf den Dämmen der Peschiera di Nora treten vereinzelt Bastarde mit *Limonium virgatum* auf, die habituell eine mehr oder weniger intermediäre Stellung einnehmen, sich aber von *L. carisae* durch zierlichere Stengel und Äste, längere Ähren und lockerer angeordnete Ährchen unterscheiden.

Limonium carisae Erben x ***Limonium dubium*** (Guss.) R.Litard.

Auch dieser Bastard ist nur von der Typuslokalität her bekannt. Er ist von *Limonium carisae* durch seine zierlicheren und deutlich breiteren Inflorerszenzen, längeren Ähren, weiter auseinander stehenden Ährchen sowie durch kleineren Brakteen und Kelch deutlich getrennt.

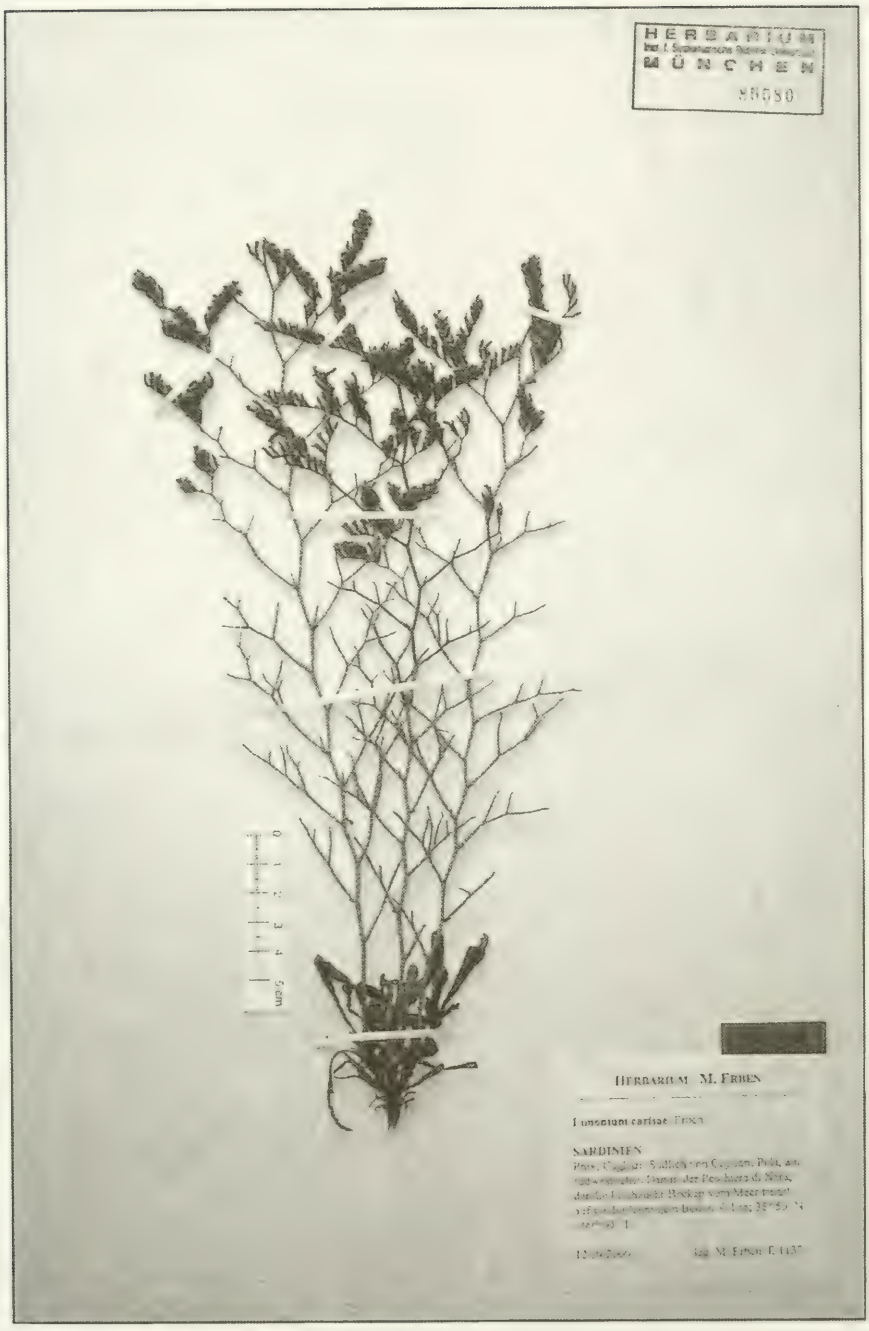

Abb. 11: *Limonium carisae* Erben

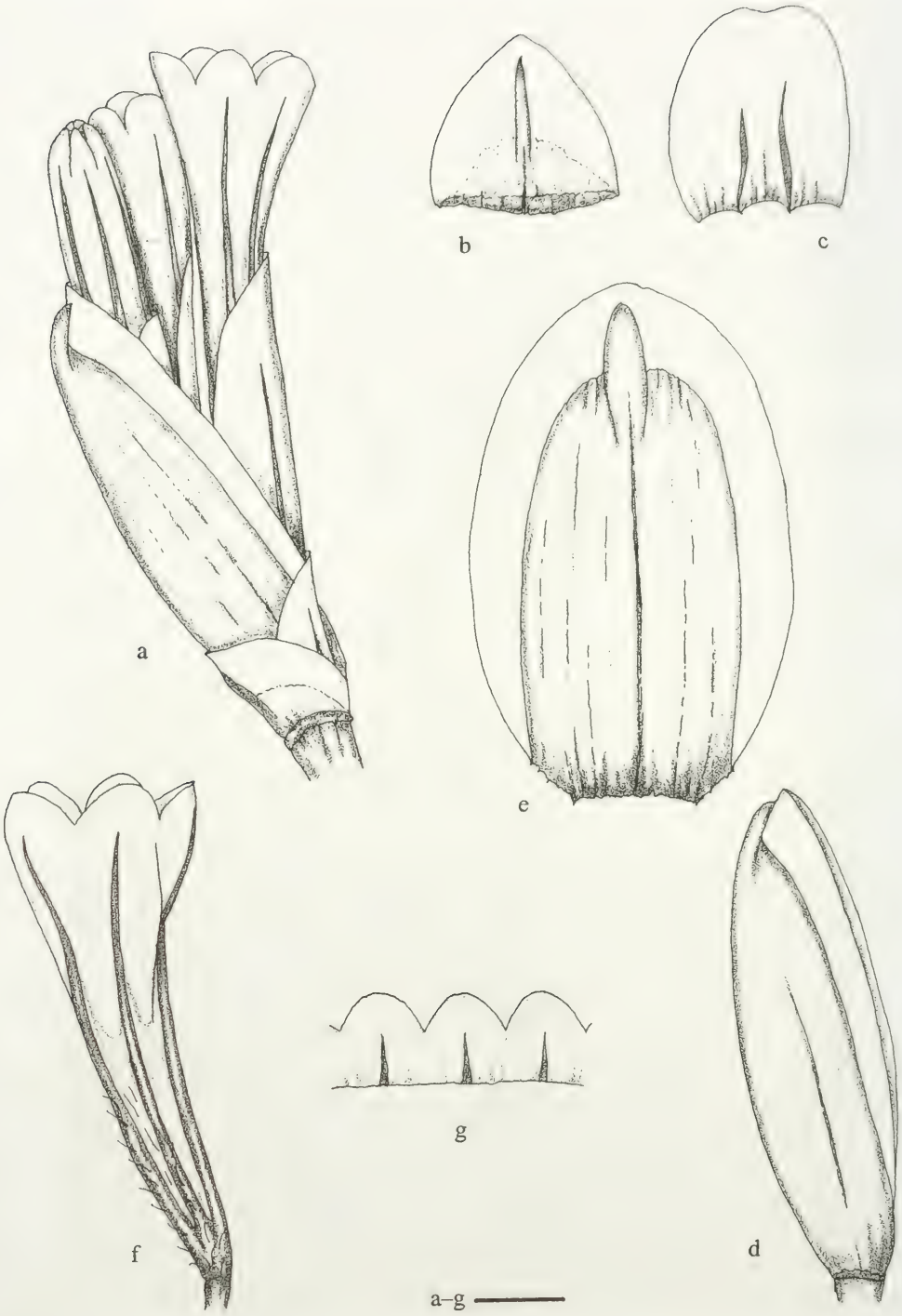

Abb. 12: a: Ährchen; b: äußere Braktee; c: mittlere Braktee; d: innere Braktee (Seitenansicht); e: innere Braktee (Rückenansicht); f: Kelch; g: Kelchzähne. Maßstab: 1 mm.

7. ***Limonium fesianum*** Erben, spec. nov.
Holotypus: Marokko, Prov. Fes: Bounasseur, terrain gypseux ; 34°06' N – 05°06′ W, 4.4. 1988, *Aberlin* (MSB 86933; Isotypen: Herb. Aberlin).

Abb.: 13–14

Planta perennis, caules steriles et fertiles formans, partim breviter pilosa, pilis in verrucis planis aggregatis. Caudiculi 1–5 cm longi, in parte superiore ramosi. Folia 15–40(–60) mm longa et 4–11 mm lata, plus minusve anguste spatulata, rotunda vel subemarginata, 1-nervia, plana, supra atro-viridia; petiolum 1–2,5 mm latum, circiter 1/3 longitudinis laminae attingens. Caules steriles erecti ad oblique sursum spectantes, 8–15 cm longi, flexuosi, dense compluries dichotomiforme ramosi; caules fertiles longiores, usque ad 60 cm longi, subrecti, laxe distiche ramosi. Rami generaliter omnes fertiles, distiche dispositi, 6–20 cm longi, oblique sursum spectantes ad arcuate effusi, sub angulis 60°–70° abeuntes, solum laxe ramosi. Inflorescentia paniculata, forma late trullata. Spicae 5–25 mm longae, subrectae. Spiculae 7,0–7,5 mm longae, 1-florae, laxe ad dense ad 4–8 in 1 centimetro dispositae, non vel partim mutue attingentes. Bractea inferior 1,4–1,9 mm longa et 1,5–1,9 mm lata, triangularis ad triangulari-ovata, acuta, margine late membranaceo, parte centrali carnosula, acuminata, acumine tenui marginem omnino vel fere attingente. Bractea media 1,5–2,0 mm longa et 1,2–1,8 mm lata, oblongo-elliptica, asymmetrice biloba, costa longiore laxe pilosa. Bractea superior 4,1–4,5 mm longa et 3,2–3,6 mm lata, ovata, rotunda, margine late membranaceo, parte centrali carnosula, imprimis in parte superiore pilosa, 3,0–3,2 mm longa et 2,1–2,3 mm lata, oblongo-elliptica, acuminata, acumine tenui, 0,9–1,0 mm longo, marginem non attingente. Calyx 5,8–6,8 mm longus, ex bractea superiore 2,5–3,0 mm exsertus, tubo plus minusve dense longe piloso; limbus imprimis post florendi tempus hypocratiformis, plicatus; dentes calycis circiter 1,0 × 1,8 mm, triangulares; costae tubi in acuminibus dentium desinentes. Petala 9,5–10,5 mm longa et 2,2–2,5 mm lata, spatulato-cuneata, rotundata, rubro-violacea. Corolla diametro 7–8 mm. Chromosomatum numerus: 2n = 18.

Pflanze ausdauernd, sowohl sterile wie fertile Stengel bildend, teilweise kurz behaart; Haare in Gruppen auf flachen Warzen angeordnet. Stämmchen 1–5 cm lang, am oberen Ende verzweigt. Blätter 15–40(–60) mm lang und 4–11 mm breit, mehr oder weniger schmal spatelförmig, am oberen Ende rund oder leicht ausgerandet, 1-nervig, eben, oberseits dunkelgrün; Stiel 1–2,5 mm breit, ca. 1/3 der Spreitenlänge erreichend. Sterile Stengel aufrecht bis schräg nach oben gerichtet, 8–15 cm lang, zickzackförmig gebogen, dicht mehrmals dichotomartig verzweigt; fertile Stengel bedeutend länger, je nach Standort bis zu 60 cm lang, nahezu gerade, locker zweiseitswendig verzweigt. Äste normalerweise alle fertil, zweiseitswendig angeordnet, 6–20 cm lang, schräg nach oben gerichtet bis bogenförmig ausgebreitet (Verzweigungswinkel 60°–70°), nur locker verzweigt. Infloreszenz rispenförmig, im Umriss breit trullat. Ähren 5–25 mm lang, nahezu gerade. Ährchen 7,0–7,5 mm lang, 1-blütig, locker bis dicht zu 4–8 pro Zentimeter angeordnet, sich nicht oder nur teilweise berührend. Äußere Braktee 1,4–1,9 mm lang und 1,5–1,9 mm breit, dreieckig bis dreieckig-eiförmig, am oberen Ende spitz; Rand breit häutig; zentraler Bereich nur etwas fleischig, mit einer feinen, fast oder ganz bis zum Rand reichenden Spitze. Mittlere Braktee 1,5–2,0 mm lang und 1,2–1,8 mm breit, länglich elliptisch, am oberen Ende asymmetrisch zweilappig; größere Rippe mit einzelnen Haaren besetzt. Innere Braktee 4,1–4,5 m lang und 3,2–3,6 mm breit, obovat, am oberen Ende rund; Rand breit weißhäutig; zentraler Bereich nur etwas fleischig, vor allem in der oberen Hälfte behaart, 3,0–3,2 mm lang und 2,1–2,3 mm breit, länglich-elliptisch, mit einer 0,9–1,0 mm langen, feinen, nicht bis zum Rand reichenden Spitze. Kelch 5,8–6,8 mm lang, die innere Braktee um 2,5–3,0 mm überragend; Kelchröhre mehr oder weniger dicht lang seidig behaart; Kelchsaum vor allem nach der Blütezeit stieltellerartig ausgebreitet, fein gefaltet, mit ca. 1,0 ×

Abb. 13: *Limonium festianum* Erben

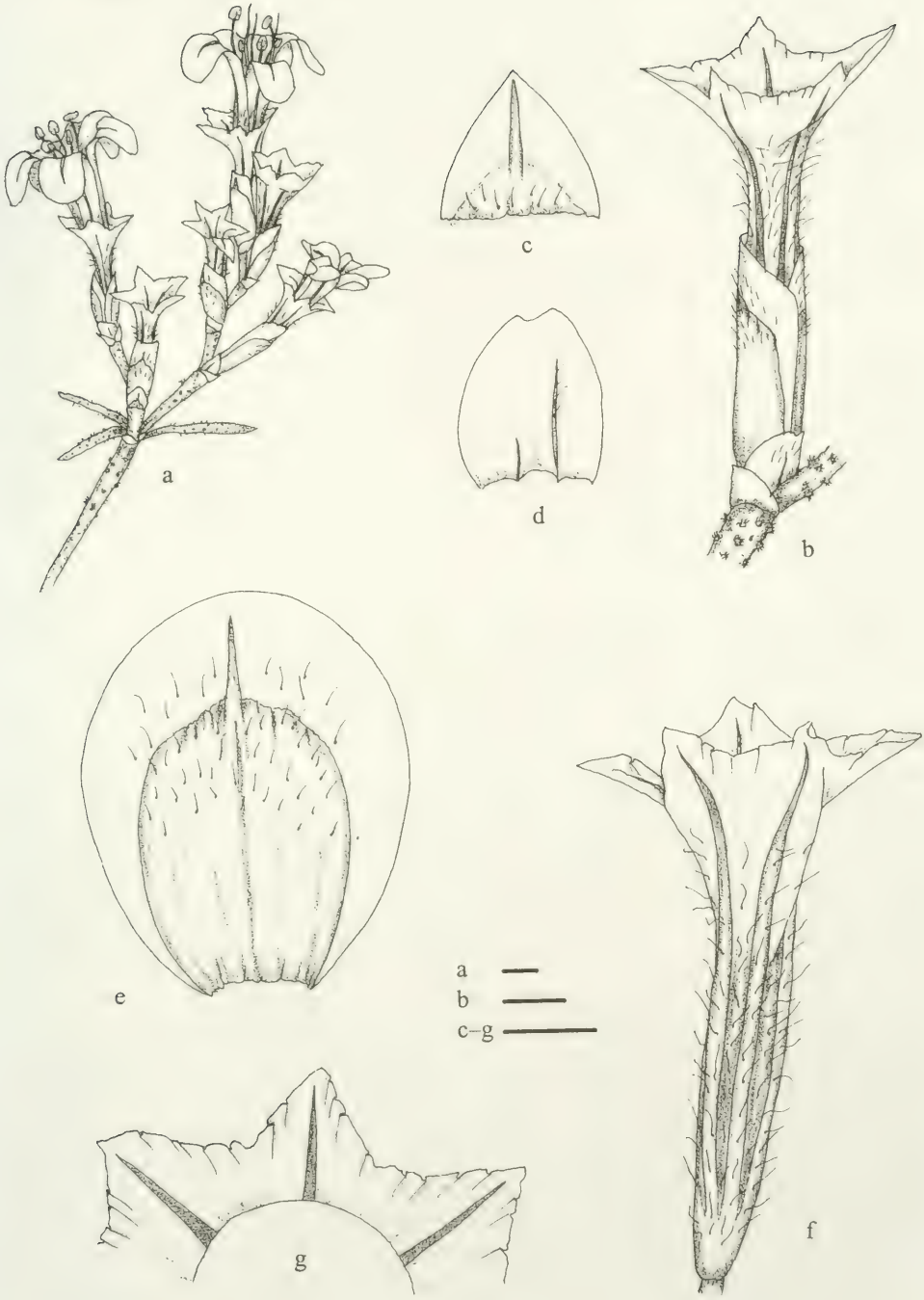

Abb. 14: a: Ähre; b: Ährchen; c: äußere Braktee; d: mittlere Braktee; e: innere Braktee; f: Kelch; g: Kelchzähne. Maßstab: 1 mm.

1,8 mm großen dreieckigen Zähnen; Rippen der Kelchröhre in den Spitzen der Kelchzähne auslaufend. Kronblätter 9,5–10,5 mm lang und 2,2–2,5 mm breit, spatelig-keilförmig, am oberen Ende abgerundet, pinkfarben. Blütendurchmesser 7–8 mm. Chromosomenzahl: 2n = 18; untersucht wurden Exemplare der Aufsammlungen Li-1477 und Li-1559.

Limonium fesianum ist bisher nur von zwei Stellen bekannt, die etwa 20 bzw. 40 km WNW von Fes liegen. Sie besiedelt dort vorwiegend die oberen Kanten gipshaltiger Abhänge, in deren Talsohlen große Mengen Salz zu Tage treten.

Diese neue Art dürfte am ehesten in die nähere Verwandtschaft der ebenfalls diploiden *Limonium asparagoides* (Coss. & Dur.) Maire zu stellen sein. Beide Sippen bilden sowohl sterile wie fertile Stengel aus, ihre Äste sind reich verzweigt und beide haben pinkfarbene Blüten. *L. fesianum* ist jedoch von *L. asparagoides* durch seine Behaarung und seine weniger fein verzweigten Äste und Ästchen leicht zu trennen.

Untersuchte Aufsammlungen:

Marokko. Prov. Fes: Bounasser, terrain gypseux (schriftlich von J.-P. Aberlin ergänzt: Straße Fes-Sidi Kacem, ca. 22 km WNW von Fes und ca. 5 km NO des Dorfes Nzala des Oudaya, auf gipshaltigen, nach Südosten abfallenden Steilhängen des Kaf Hemam), 34°06' N – 05°16´ W, 4.4. 1988, *Aberlin* (Li-1477) (MSB, Herb. Aberlin, Herb. Erben) – 4 km E Nzala-des-Beni-Ammar, ca. 40 km WNW Fes nahe der Straße nach Sidi Kacem, Gips-und Salzböden; 34°04' N – 05°18´ W, 14.4. 1995, *Podlech et al.* (Li-1559) (Herb. Erben).

8. *Limonium comosum* Erben, spec. nov.

Holotypus: Tunesien, Gouv. de Medenine: Südwestlich von Ben Gardane, Sebkha El Makhlzène bei Smar, 13.–20.6.1994, *Kramer* (MSB 85560; Isotypen: Herb. Erben).

Abb.: 15–16

Planta perennis, glabra, oligocaulis, habitu simili arbori comosae. Caudiculi 5–40 cm longi, densissime spiraliter foliosi. Folia in partibus 2/3 inferioribus emarcida, dependentia, in parte 1/3 superiore persistentia, griseo-viridia, erecta, 35–120 mm longa et 5–17 mm lata, lanceolata, acuta ad obtusa, acuminata, marginibus lateralibus angustissime membranaceis, subtus 3–5-nervia, in petiolum brevem 2–6 mm latum tarde attenuata. Caules validi, 20–50 cm longi, erecti, subflexuosi, in partibus 2/3 superioribus laxe ramosi. Rami distiche dispositi, interdum ramis 2–3 in axillis foliorum squamiformium exorientibus, plerumque omnes fertiles, 5–20 cm longi, arcuate effusi, oblique sursum spectantes, sub angulis 65°–80° abeuntes, non vel laxe ramosi; ramuli secunde sursum spectantes. Inflorescentia paniculata, forma anguste ad late triangulari vel late trullata. Spicae brevissime petiolatae ad subsessiles, 10–30 mm longae, laxe ad dense vel conglomerate dispositae, generaliter secunde sursum spectantes, rectae ad subarcuatae. Spiculae 6,0–6,5 mm longae, 1-florae, densissime ad 8–12 in 1 centimetro dispositae, mutue attingentes. Bractea inferior fere omnino membranacea, 3,0–3,5 mm longa et 2,5–3,0 mm lata, oblongo-ovata, cuspidata, in parte superiore subundulata et patente. Bractea media 2,5–2,9 mm longa et 1,8–2,8 mm lata, oblongo-elliptica ad oblongo-obovata, symmetrice vel asymmetrice biloba, costa longiore marginem fere attingente, in parte 1/3 superiore plicas majores 2 formante; bractea media et bractea inferior bracteam superiorem calyciformiter cingentes. Bractea superior convoluta, 5,5–6,0 mm longa et 4,5–5,1 mm lata, elliptica ad obovata, obtusa, in parte superiore undulata et patente, marginibus lateralibus angustissime membranaceis, parte centrali acuminata, acumine 1,2–1,5 mm longo marginem contingente. Calyx tenuissimus, 4,5–5,5 mm longus, ex bractea superiore 0,5–1,0 mm exsertus, tubo imprimis unilateraliter sparsim ad dense breviter piloso; dentes calycis ca. 0,4 × 0,8 mm,

semi-elliptici ad triangulari-ovati; costae tubi ad basim dentium calycis desinentes. Petala pallide rubro-violacea, circiter 7,5 mm longa et 2,2 mm lata, anguste cuneata, emarginata.

Pflanze ausdauernd, kahl, wenigstengelig, mit „schopfbäumchenartigem" Wuchs. Stämmchen 5–40 cm lang, sehr dicht schraubig beblättert. Blätter in den unteren 2/3 der Stämmchen verwelkt und nach unten hängend, nur im oberen Drittel lebend, graugrün, aufrecht, 35–120 mm lang und 5–17 mm breit; Spreite lanzettlich, am oberen Ende spitz bis stumpf, mit einer 1–2 mm langen Stachelspitze, an den Rändern sehr schmal weißhäutig, unterseits mit einem deutlich sichtbaren Hauptnerv und 2–4 feinen Seitennerven, allmählich in einen kurzen, 2–6 mm breiten Stiel übergehend; Stiel zur Basis hin sich wieder langsam verbreiternd. Stengel kräftig, 25–50 cm lang, aufrecht, schwach zickzackförmig gebogen, in den oberen 2/3 locker verzweigt. Äste zweiseitswendig angeordnet, bisweilen auch 2–3 Äste in der Achsel eines Schuppenblattes entspringend, normalerweise alle fertil, 5–20 cm lang, bogenförmig ausgebreitet bis schräg nach oben gerichtet (Verzweigungswinkel 65°–80°), nicht oder nur locker verzweigt. Ästchen einseitswendig nach oben gerichtet. Infloreszenz rispenartig, im Umriss schmal bis breit dreieckig oder auch breit trullat. Ähren sehr kurz gestielt bis scheinbar sitzend, 10–30 mm lang, locker bis dicht oder sogar knäuelartig angeordnet, normalerweise einseitswendig nach oben gerichtet, gerade bis leicht bogenförmig. Ährchen 6,0–6,5 mm lang, 1-blütig, sehr dicht stehend zu 8–12 pro Zentimeter, sich gegenseitig berührend. Äußere Braktee nahezu vollständig häutig, 3,0–3,5 mm lang und 2,5–3,0 mm breit, länglich-obovat, am oberen Ende zu einer Spitze ausgezogen, leicht gewellt und etwas nach außen gebogen; Spitze des zentralen Bereichs nur im oberen Drittel der Braktee ausgebildet, fast den Rand erreichend. Mittlere Braktee 2,5–2,9 mm lang und 1,8–2,8 mm breit, länglich-elliptisch bis länglich-obovat, am oberen Ende gewellt, asymmetrisch bis symmetrisch zweilappig oder auch mit zwei großen und einem kleinen, dazwischenliegenden Zahn; größere Rippe bis zum oberen Rand reichend; Braktee im oberen Drittel zwei größere, nach außen gebogene Falten bildend; mittlere und äußere Braktee die innere Braktee becherförmig umgebend. Innere Braktee tütenförmig eingerollt, 5,5–6,0 mm lang und 4,2–5,1 mm breit, elliptisch bis obovat, am oberen Ende stumpf; seitliche Ränder sehr schmal weißhäutig; zentraler Bereich mit einer 1,2–1,5 mm langen, bis zum Rand reichenden Spitze; Braktee im Bereich der Spitze nach außen gebogen. Kelch sehr zart, 4,5–5,5 mm lang, die innere Braktee nur um 0,5–1,0 mm überragend; Kelchröhre vor allem auf einer Hälfte spärlich bis dicht kurz behaart; Kelchzähne ca. 0,4 × 0,8 mm, halbelliptisch bis dreieckig-eiförmig; Rippen der Kelchröhre an der Kelchzahnbasis auslaufend. Kronblätter blass rotviolett, ca. 7,5 mm lang und 2,2 mm breit, schmal keilförmig, am oberen Ende ausgerandet.

Diese neue Sippe ist bisher nur von einem sehr kleinen Gebiet aus Süd-Tunesien bekannt, das sich von El Marsa bis zum Sebkha El Makhlzène erstreckt. Sie besiedelt trockene, sandig-steinige Küstenflächen oder kleine Erhebungen in Salzsümpfen oder deren Uferbereiche.

Unzweifelhaft ist *Limonium comosum* sehr nah mit der weiter im Norden Tunesiens vorkommenden Sippe *L. tunetanum* (Bonnet & Barratte) Maire verwandt, von der sie auch auf den ersten Blick kaum zu unterscheiden ist. Beide Sippen zeigen einen „schopfbaumartigen" Wuchs, besitzen dicht schraubig angeordnete, lanzettliche Blätter und bilden weit ausladende Infloreszenzen. Erst bei näherer Betrachtung fallen bei *L. comosum* ihre stärker zugespitzen Blätter, ihre längeren Ähren sowie ihre deutlich größeren Ährchen auf (s. Abb. 16).

Untersuchte Aufsammlungen:

Tunesien. Gouv. de Medenine: El Marsa (Ben Gardane), 24.6.1984, *Brullo & Funnari* (CAT, Herb. Erben) – südwestlich von Ben Gardane, Sebkha El Makhlzène bei Smar, 13.–20.6.1994, *Kramer* (MSB, Herb. Erben, Herb. Kramer).

Abb. 15: *Limonium comosum* Erben

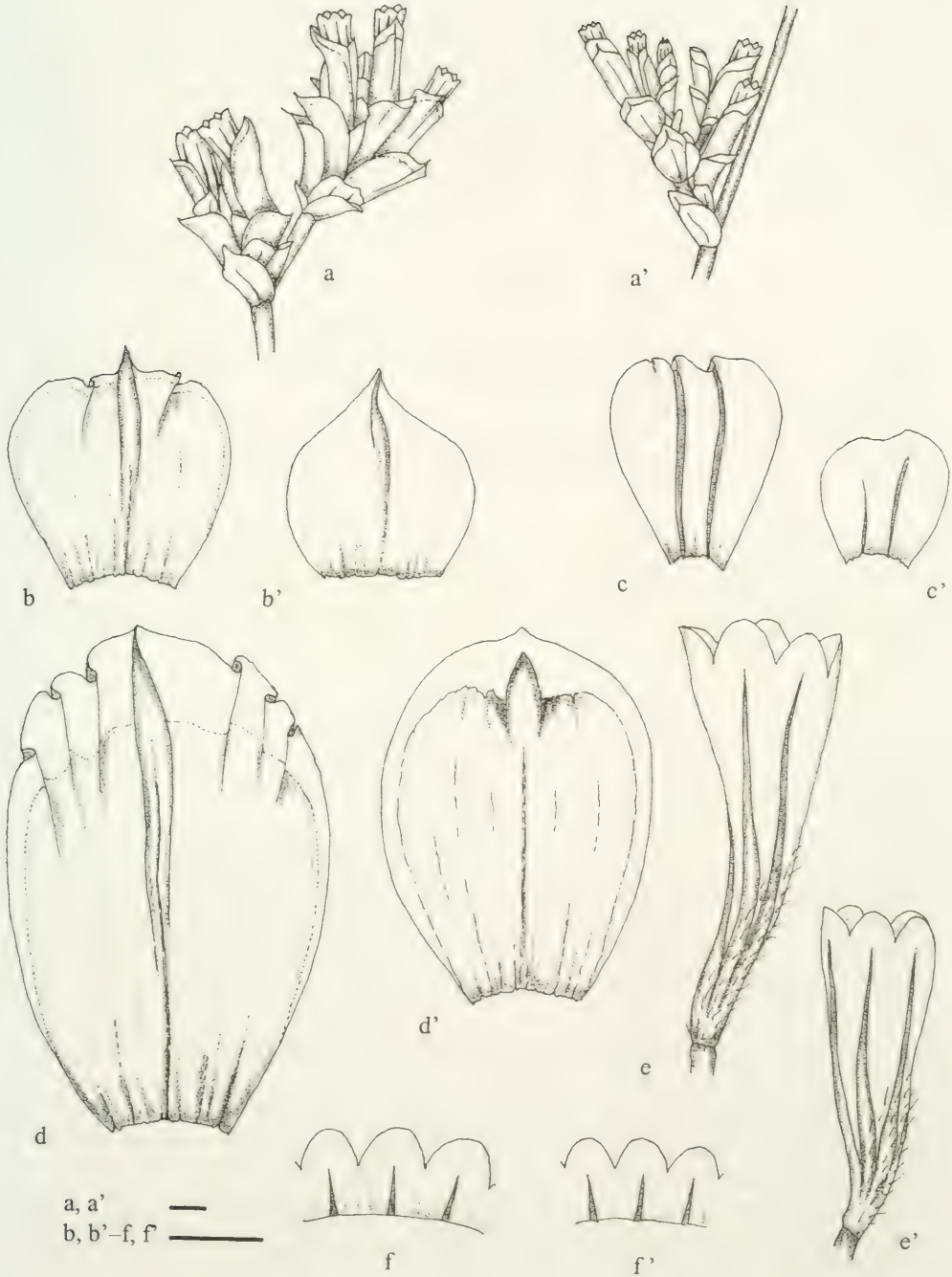

Abb. 16: *L. comosum*: a: Ährchen; b: äußere Braktee; c: mittlere Braktee; d: innere Braktee; e: Kelch; f: Kelchzähne. *L. tunetanum*: a': Ährchen; b': äußere Braktee; c': mittlere Braktee; d': innere Braktee; e': Kelch; f': Kelchzähne. Maßstab: 1 mm.

An dieser Stelle möchte ich mich namentlich bei den Personen bedanken, die mir in besonderer Weise bei diesen Neubeschreibungen geholfen bzw. diese erst ermöglicht haben. Bei der Klärung der Art *Limonium caralitanum* waren mir Prof. P.V. Arrigoni (Firenze) und Prof. S. Pignatti (Roma) behilflich. Jean-Pierre Aberlin (Besancon) hat *Limonium fesianum* entdeckt und mir einen Herbarbeleg nebst einer exakten Beschreibung des Fundortes zukommen lassen. Frau Prof. Isolde Ullmann (Würzburg) und Herr Matthias Kramer (Würzburg) haben mir ihr Pflanzenmaterial von *Limonium comosum* zur Verfügung gestellt. Schließlich schulde ich noch Dank der Leitung des Muséum National d'Histoire Naturelle (Paris) für das Ausleihen der Syntypen von *Limonium tunetanum*. Erst die Untersuchung dieser Bögen zeigte, dass die von Herrn Kramer gesammelten Pflanzen nicht mit *L. tunetanum* identisch waren.

II. Nomenklatorische Änderungen

1. ***Limonium ursanum*** Erben in Mitt. Bot. Staatssamml. München 22: 214 (1986)
Holotypus: Sardinien, Prov. Sassari: Costa Smeralda, Cala di Volpe, felsige Sandsteinküste bei Capriccioli, 23.8.1974, *Erben E 111* (M).
= ***Limonium coralliforme*** A.Mayer in Libri Botanici 15: 66 (1995), syn. nov.
Holotypus: Italy, NE coast of Sardinia, Punta dell' Asino, south of Budoni, 12.8.1988, *A. Mayer No. 0600* (M).

2. ***Limonium bollei*** (Wangerin) Erben, comb. nov.
≡ ***Statice bollei*** Wangerin in Repert. Spec. Nov. Regni Veg. 17: 401 (1921). Lectotypus (hic design.): Isleta de Lobos, Canaries, 1852, *Bolle* (sub *Statice ovalifolia*) (Z!).
= ***Limonium ovalifolium*** (Poir.) O.Kuntze subsp. ***canariense*** Pignatti in Collect. Bot. (Barcelona) 6: 317 (1962).

III. Typifizierungen

1. ***Limonium dubium*** (Guss.) R. Litard. in Candollea 11: 212 (1948)
≡ ***Statice dubia*** Guss. in Suppl. Fl. Sicul. Prodr.: 89 (1832)
= ***Statice dictyoclada*** Boiss. var. ***dubia*** (Guss.) Boiss. in DC., Prodr. 12: 634 (1848). Gussone zitiert in seiner Diagnose folgende Syntypen: „In humentibus arenosis maritimis; Trapani, Levanzo." Da er im der Diagnose nachfolgendem Text u.a. schreibt: „Sub specifico designato nomine in herbario Cl. Dec. Specimina vidi", wähle ich aus dem Herbar DC. folgende Aufsammlung zum Lectotypus (hic design.): Trapani, *Gussone* (sub *Statice dictyoclada* var. *dubia*) (G-Boiss.).

2. ***Limonium tunetanum*** (Bonnet & Barratte) Maire in Mém. Soc. Hist. Nat. Afrique No. 3: 166 (1933)
≡ ***Statice tunetana*** Bonnet & Barratte in Expl. sci. Tunisie, Cat. pl.: 353 (1896). Bonnet & Barratte geben in ihrer Beschreibung dieser Art folgende Syntypen an: „Sables de la Tunisie méridionale: Gabès (Rob.), Sidi-Salem-bou-Grara, Kebilli (Letourn.), Tozzer" an. Aus diesen Belegen wähle ich folgende Aufsammlung, da sie die größte Übereinstimmung mit ihrer Tafel 15 (in Explor. sci. Tunisie, Ill. bot., 1895) aufweist, zum Lectotypus (hic design.): Kebilli (Nefzaoua) in palmatis, 29.–30. Maio 1884, *A. Letourneux* (P-Herb. Cosson).

Dr. Matthias ERBEN, Institut für Systematische Botanik der Ludwig-Maximilians-Universität München, Menzinger Straße 67, D-80638 München, Deutschland.

Contributions to the Flora of Northern Africa, I. New or noteworthy taxa

H. FÖRTHER & D. PODLECH

Abstract:
FÖRTHER, H. & PODLECH, D.: Contributions to the Flora of Northern Africa, I. New or noteworthy taxa. – Sendtnera 7: 85–91. 2001. ISSN 0944–0178.

The following taxa are new to Morocco: *Erodium microphyllum* Pomel, *Orobanche leptantha* Pomel, *Scorzonera coronopifolia* Desf., to Algeria: *Potamogeton schweinfurthii* A.Benn., *Solanum sinaicum* Boiss., to Tunisia: *Helichrysum stoechas* (L.) Moench subsp. *conglobatum* (Viv.) Maire & Weiller. The following taxa are changed in rank: *Drimia maritima* (L.) W.T.Stearn subsp. *maura* (Maire) Förther & Podlech, *Hyacinthoides hispanica* (Mill.) Rothm. subsp. *algeriensis* (Batt.) Förther & Podlech, *Erodium maroccanum* (Maire) Förther & Podlech, *Aaronsohnia pubescens* (Desf.) Bremer & Humphries subsp. *maroccana* (Ball) Förther & Podlech. One species, *Pulicaria antiatlantica* Förther & Podlech and one subspecies, *Centaurea pungens* Pomel subsp. *austromaroccana* Förther & Podlech are described as new. *Teucrium demnatense* is reinstated as a legitime name.

Zusammenfassung:
Folgende Sippen sind neu für Marokko: *Erodium microphyllum* Pomel, *Orobanche leptantha* Pomel, *Scorzonera coronopifolia* Desf., für Algerien: *Potamogeton schweinfurthii* A.Benn., *Solanum sinaicum* Boiss., für Tunesien: *Helichrysum stoechas* (L.) Moench subsp. *conglobatum* (Viv.) Maire & Weiller. Die folgenden Taxa werden in der Rangstufe verändert: *Drimia maritima* (L.) W.T.Stearn subsp. *maura* (Maire) Förther & Podlech, *Hyacinthoides hispanica* (Mill.) Rothm. subsp. *algeriensis* (Batt.) Förther & Podlech, *Erodium maroccanum* (Maire) Förther & Podlech und *Aaronsohnia pubescens* (Desf.) Bremer & Humphries subsp. *maroccana* (Ball) Förther & Podlech. Eine neue Art, *Pulicaria antiatlantica* Förther & Podlech und eine neue Unterart, *Centaurea pungens* Pomel subsp. *austromaroccana* Förther & Podlech werden beschrieben. *Teucrium demnatense* wird als legitimer Name wieder eingesetzt.

The flora of North Africa comprises of approximately 10.000 species of flowering plants according to HEYWOOD & DAVIS (1994). Morocco with about 3600 species and ca. 600–650 endemics has the richest flora of that area, but a complete actual inventary is still missing. The increasing human influence on this outstanding rich flora is serious. Population growth is directly or indirectly related to the loss of plant biodiversity. Deforestation, clearance of land for agriculture, overgrazing and excessive use of ground water leads to severe degradation of the original vegetation, loss of species diversity, soil degradation and desertification.

Since JAHANDIEZ & MAIRE (1931–1934), EMBERGER & MAIRE (1941) and the incomplete flora of MAIRE (1952–1980) only few general investigations of the floristic diversity took place. Since many years the "Institut für Systematische Botanik" makes efforts in documentation of the flora of that area. It is planned to publish the results of that efforts in a series of papers. The changed rating of taxa requires some nomenclatural corrections, new taxa are found to be described or hithero less known taxa are worth to be more notified.

Potamogetonaceae

Potamogeton schweinfurthii A.Benn. in Dyer, Fl. Trop. Afr. 8: 220. 1901.

New to Algeria.

Algeria. Wil. Ouargla: Tassili n'Ajjer, Iherir, 1070 m; Wasserstelle, [8°24'E, 25°24'N], 31.3.1982, *Podlech 36968* (G, LG, M, MSB).

Hyacinthaceae

W.T.STEARN in a paper about the genus *Urginea* has united this genus with the older genus *Drimia*. Within the wide-spread and polymorphic *Drimia maritima* (L.) W.T.Stearn (Syn.: *Urginea maritima* (L.) Baker) *Urginea maura* Maire as a montane taxon shows a geographic-ecological independence, but in the Flore d'Afrique du Nord (1958) it is only accepted as variety of *Urginea maritima*. Because of the morphological and geographic-ecological differences it is better placed in the rank of a subspecies:

Drimia maritima (L.) W.T.Stearn subsp. ***maura*** (Maire) Förther & Podlech, comb. nov.
Basionym: *Urginea maura* Maire, Bull. Soc. Hist. Nat. Afr. Nord 14: 158. 1923.

Specimens seen:

Morocco. Prov. Taroudant: Tizi-n-Test an der Straße von Taroudant nach Marrakech (501), 2100 m; stark überweidete Hänge an der Passhöhe, 9.8.1999, *Podlech 55287* (MSB). – Prov. Azilal: ca. 30 km S Pont Naturel an der Straße von Demnate nach Toufrine, 1840 m, 13.8.1999, *Podlech 55356* (MSB). – Prov. Ouarzazate: 5 km S unterhalb des Tizi-n-Tichka, an der Straße von Marrakech nach Ouarzazate, 2180 m, 14.8.1999, *Podlech 55374* (MSB).

Hyacinthoides hispanica (Mill.) Rothm. subsp. ***algeriensis*** (Batt.) Förther & Podlech, comb. et stat. nov.
Basionym: *Endymion patulus* (Lam. & DC.) Dumort. var. *algeriensis* Batt., Bull. Soc. Bot. France 27: 164. 1880.

Because of the morphological and geographic-ecological differences this taxon is better accepted in the rank of a subspecies.

Specimen seen:

Morocco. Prov. Ifrane (Meknès): Mittlerer Atlas, Cascades des Vierges, NW Ifrane, 1570 m; feuchte Wälder, Trockenflächen, 13.5.1989, *Podlech 46592* (G, LG, MSB).

Geraniaceae

Erodium maroccanum (Maire) Förther & Podlech, comb. nov.

Basionym: *Erodium hirtum* Willd. var. *maroccanum* Maire, Bull. Soc. Hist. Nat. Afrique Nord 14: 135. 1923. Typus: Cap Ghir, in pascuis arenosis et lapidosis calcareis Imperii Maroccani austro-occidentalis ad promontorium Ghir, ubi Martii et Aprili floret (Univ. Algier, RAB).

Perennial, branches up to 30 cm high, erect or ascending, basally stout and suffrutescent, loosely furnished with spreading greyish-white hairs. Petiole of basal leaves up to 10.5 cm long, very short in upper cauline leaves; lamina triangular-ovate in outline, 1.5–6 cm long, 0.8–5 cm wide, deeply 1–2-pinnatisect, the lobes pinnatifid or deeply dentate, surface puberulent, hispid or sometimes glabrescent; stipules ovate to widely triangular, purplish-brown, hispid, ciliate at the margin. Inflorescence 8–22 mm long, umbel consisting of 3–5 flowers; bracts scarious, light brown, widely ovate, hairy. Flowers pale pink or pink with violet centre, 14–18 mm in diameter. Pedicels 8–15 mm long, deflexed in fruit. Sepals 6–7 mm long, 3–4 mm wide, ovate-oblong, mucronate, hairy, only slightly enlarging in fruit. Petals ca. 8 mm long, obovate. Mericarps ca. 4–5 mm long, brown, with antrorse hairs, apical pits small, with two conspicous furrows below; beak 4.4–6 cm long, not or scarcely spirally twisted, with numerous long, brownish hairs at the inner side.

Specimens seen:

Morocco. Prov. Layoune: 13 km N Daourah an der Straße von Tarfaya nach Layoune (P41), E-Rand der Sebkha Oum-Deboua [12°58'W, 27°37'N], ca. 40 m, 11.4.1986, *Podlech 40473* (MSB). – Prov. Tan-Tan: 3 km S des Flughafens Tan-Tan am Steilabbruch zum Oued Ben Khlil S von Tan-Tan [11°09'W, 28°58'N], 60–100 m, 30.3.1990, *Podlech 48714* (G, LG, MSB, P, RAB) – Oued Aabar, ca. 7 km N Abtih E der Straße von Tan-Tan nach Samara (P 44), 40–60 m; sandig-salzige Flächen, steinige Hänge [11°25'W, 28°00'N], 31.3.1990, *Podlech 48817* (MSB). – Prov. Goulimime: S-Ufer des Oued Draa an der Straße von Goulimime nach Tan-Tan (P41) [10°58'W, 28°32'N], 60 m, 10.4.1986, *Podlech 40398* (MSB).

Erodium maroccanum is an endemic of the dry coastal regions of south-western Morocco. It differs from *Erodium crassifolium* L'Hér. (Syn.: *A. hirtum* Willd.) in a more dense indument, the significant larger flowers and the much shorter fruits.

Erodium microphyllum Pomel, Nouv. Mat. Fl. Atlant.: 339. 1874.

New to Morocco:

Morocco. Prov. Ouarzazate: Paßhöhe Tizi-n-Tinfift, ca. 20 km W Agdz an der Straße nach Ouarzazate (P31) [6°37'W, 30°44'N], 1650 m, 11.4.1990, *Podlech 49516* (MSB).

Formerly only known from Algeria and Tunesia the specimen cited above is the first record for the flora of Morocco.

Solanaceae

Solanum sinaicum Boiss., Diagn. pl. orient. ser. 1, 11: 135. 1849.

New to the flora of Algeria.

This suffruticose species has been detected in the Hoggar mountains in the central Sahara of Algeria. It seems to be rather common there at higher altitudes and replaces to a large extent the annual *Solanum nigrum* L. with which it was always confused. The plants agree completely with the type of *S. sinaicum* and other specimens from Sinai and they also have the same ecology.

Specimens seen:

Algeria. Wil. Tamanrasset: Hoggar-Massif, Umgebung des Guelta Afilale, nahe der Straße von Tamanrasset zum Assekrem, 2050 m; Felsen, Sand, sumpfige Stellen [5°45'E, 28°08'N], 24.3.1980, *Podlech 33345, 33346* (MSB) – dto., 19.3.1981, *Podlech 34904* (G, LG, M, MSB) – Hoggar-Massif, Guelta Issakarassene an der Piste von Hirafok zum Assekrem, 1930 m, Wasserstellen, Felsen und sandige Flächen [5°45'E, 23°25'N], 20.3.1981, *Podlech 34971* (MSB) – Hoggar-Massif, Wasserstellen im Oued Ilamane, 10 km SW Ilamane, 1800 m, Sand, Felsen [5°24'E, 23°10'N], 24.3.1982, *Podlech 36753* (MSB) – Tefedest-Gebirge, Guelta im Oued Dehine, 10 km (Luftlinie) NE Mertoutek, 1180 m, sandig-steiniges, salzhaltiges Oued [5°38'E, 24°16'N], 27.3.1982, *Podlech 36874* (MSB).

Lamiaceae

Teucrium demnatense Batt., Contr. Fl. Atl.: 74. 1914.

GREUTER & BURDET have replaced the illegitime name *Teucrium collinum* Coss. & Balansa non Salisb. by *T. collincola* Greuter & Burdet, Willdenowia 15: 79. 1985. This species is identical with *T. demnatense* which therefore is the valid older name. The name *T. demnatense* is missing in GREUTER, BURDET & LONG (1986).

Orobanchaceae

Orobanche leptantha Pomel, Bull. Soc. Sci. Phys. Algérie 11: 110. 1874.

New to Morocco.

This species, described by Pomel from the surroundings of Oran in Algeria, could be found in Morocco near the frontier to Algeria.

Specimens seen:

Morocco. Prov. Oujda: Schlucht 3 km S Saidia; Felsen an der Straße P 18 nach Ahfir, 40 m, Wiese [2°13'W, 35°03'N], 8.4.1993, *Förther 6630* (Herb. Förther), *Podlech 51290* (BASBG, LG, MSB, RSA).

Asteraceae

Aaronsohnia pubescens (Desf.) Bremer & Humphries subsp. ***maroccana*** (Ball) Förther & Podlech, comb. nov.
Basionym: *Matricaria maroccana* Ball, J. Bot. 11: 367. 1873.

The subspecies is widely distributed in the western coastal regions of Morocco. Its area is distinctly separated from that of subsp. *pubescens* which inhabits the more desertic regions of Morocco and Algeria. It is easily to separate from the discoid subsp. *pubescens* by the ligulate marginal flowers.

Centaurea pungens Pomel, Bull. Soc. Sci. Phys. Algérie 11: 29. 1874
subsp. ***austromaroccana*** Förther & Podlech, subspec. nov.
Holotypus: Marokko, Prov. Tan Tan, 8 km SW Tan-Tan Plage an der Straße nach Tarfaya (P 41), sandig-steiniges Oued, 20 m [11°23'W, 28°26'N], 27.3.1990, *D. Podlech 48570* (MSB); Isotypus: *Schuhwerk 90/282* (M).

Differt a subspeciei typica foliis bipinnatifidis ad bipinnatis, subtus vel utrimque dense albi-tomentosis.

This new subspecies of the widely distributed *Centaurea pungens* is rather common in the coastal regions of south-western Morocco and replaces here to a large extent the typical subspecies. It is astonishing that this conspicuous and characteristic taxon has not been recognized up to now.

Specimens seen:
Morocco. Prov. Tan Tan: 10 km NE Tan-Tan an der Straße nach Goulimine (P 41), ca. 60 m [11°03'W, 28°29'N], 10.4.1986, *Podlech 40418* (BASBG, MSB) – 4 km SW Tan-Tan Plage, breites sandiges Oued nahe der Küste, 10 m [11°21'W, 28°28'N], 10.4.1986, *Podlech 40438* (MSB) – 8 km SW Tan-Tan Plage an der Straße nach Tarfaya (P 41), sandig-steiniges Oued, 20 m [11°23'W, 28°26'N], 27.3.1990, *Podlech 48570* (MSB), *Schuhwerk 90/282* (M) – Oued Chebeika, ca. 30 km SW Tan-Tan Plage an der Straße nach Tarfaya (P 41), ca. 30 m; felsige Hänge am N-Ufer, Sandflächen [11°30'W, 28°17'N], 27.3.1990, *Podlech 48592* (MSB) – 3 km S des Flughafens Tan-Tan am Steilabbruch zum Oued Ben Khlil S Tan-Tan, 60–100 m, Felsen, sandig-steinige Rinnen [11°09'W, 28°25'N], 30.3.1990, *Podlech 48747* (MSB), *Schuhwerk 90/406* (M) – 46 km SSW Tan-Tan an der Straße nach Samara (P 44), 120 m, steiniges Oued [11°17'W, 28°08'N], 30.3.1990, *Podlech 48772* (BASBG, MSB) – ca. 15 km N Abtih an der Straße von Tan-Tan nach Samara (P 44), ca. 40 m, steinige Hänge, sandiges Oued [11°21'W, 28°05'N], 30.3.1990, *Podlech 48791* (BASBG, MSB) – Oued Aabar, ca. 7 km N Abtih E der Straße von Tan-Tan nach Samara (P 44), 40–60 m, sandig-salzige Flächen, steinige Hänge [11°25'W, 28°00'N], 31.3.1990, *Podlech 48832* (MSB) – 8 km ESE Tan-Tan an der Piste nach Tilemsen, 70 m, sandiges Feld [11°03'W, 28°26'N], 2.4.1990, *Podlech 48978* (BASBG, MSB). – Prov. Layoune: 5 km SE Tarfaya an der Straße nach Layoune (P 41), 30 m, sandige Flächen [12°52'W, 27°55'N], 28.3.1990, *Podlech 48638* (MSB) – 7 km N Tak an der Straße 41 von Tarfaya nach Layoune, ca. 30 m [12°56'W, 27°44'N], 28.3.1990, *Schuhwerk 90/343* (M).

Helichrysum stoechas (L.) Moench subsp. ***conglobatum*** (Viv.) Maire & Weiller, Bull. Soc. Hist. Nat. Afr. Nord 30: 281. 1939.
Syn.: *Gnaphalium conglobatum* Viv., Fl. Lib. Spec.: 54. 1824; *Helichrysum conglobatum* (Viv.) Steud., Nomencl. Bot., ed. 2, 1: 736. 1840.

Perennial shrublet, branches ascending, 10–25 cm long, densely tomentose, silvery-greyish or white. Leaves alternate, leathery, 6–25 mm long, the basal ones spathulate, 3.5–7 mm wide and clustered, the terminal ones linear, 1–2.5 mm wide, apically rounded or subacute, margins entire and revolute, lanate to white-tomentose on both sides, becoming glabrous above. Synflorescence compound with many capitula in a globose cluster 1.8–5 cm in diameter. Capitula on very short, wooly stalks, ovoid before anthesis, later globose to widely ovate, 4–6 mm in diameter. Involucre 4–6 mm long, equalling the florets. Involucral bracts loosely imbricate, bright sulphur or yellow, glabrous or somewhat lanate at the base, at the apex rounded to subacute, the outer ones ovate, the middle ones obovate and the inner ones narrowly spathulate to narrowly obovate. Marginal florets female, central ones bisexual. Pappus setae 22–30, ca. 2.5–3 mm lang, scabrid. Corolla of central flowers ca. 3 mm long, tubular. Lobes 5, ca. 0.5 mm long, triangular, reflexed. Achene ca. 1 mm long, surface with shining white papillae.

New to Tunisia:
Tunisia. Gouv. Bizerte: Cap Blanc, 8 km N Bizerte [9°52'E, 37°20'N], 20 m, 3.4.1981, *D. Podlech 35771* (M, MSB) – dto., 17.4.1982, *D. Podlech 37292* (G, M, MSB).

Helichrysum stoechas is a variable species complex widely distributed in the Mediterranean area. A critical revision would be necessary. *Helichrysum stoechas* subsp. *conglobatum* was formerly treated in synonymy under *H. stoechas*, but we believe it is a distinct taxon. The subspecies differs from the subspecific taxa accepted by CLAPHAM in TUTIN & al. (1976: 129) by compact habit with very short branches, the spathulate and much wider basal leaves and the very compact clusters of capitula. The plants do not have an aromatic smell. It is growing in Tunisia on sand or rocks along the Mediterranean coast.

Pulicaria antiatlantica Förther & Podlech, spec. nov.
Holotype: Marokko, Prov. Tiznit, Antiatlas, Col-du-Kerdous, an der Straße von Tiznit nach Tafraout, ca. 1100 m [29°32'57"N, 9°20'32"W], 6.8.1999, *D. Podlech 55265* (MSB; Iso: E, K, M, MPU, RAB, Soc. Ech. Pl. vasc. Europe Bass. médit. no. 19760).

Differt ab *Pulicaria arabica* (L.) Cass. foliis brevioribus, angustissimis, 5–15 mm longis et 0,5–1 mm latis (nec 15–50 mm longis et 3–8 mm latis), basi angustatis (nec semiamplexicauli-auriculatis), brevissime aculeati-pilosis (nec dense sericeis), capitulis minoribus, 8–9 mm diametro (nec 10–13 mm diametro), saepissime homogamis sine floribus marginalibus ligulatis, raro floribus ligulatis evolutis.

Plants short-perennial, 20–40 cm tall. Stems erect, reddish-brown, branched, in upper parts rather densely covered with very short, acute hairs and sessile glands, mostly also with thin, spreading hairs ca. 0.5 mm long, in basal parts subglabrous. Leaves 5–15 mm long, 0.5–1 mm wide, linear, indistinctly attenuate towards the base, subacute at the apex, loosely covered with short rigid hairs and rather densely with sessile, mostly impressed blackish glands,

sometimes also with few longer simple hairs, flat or with upcurved margins or folded. Capitula in a loose panicle, solitary at the end of slender, erect or ascending side-branches 2–5 cm long. Capitula 8–9 mm in diameter. Involucrum hemispheric. Involucral bracts in ± three rows, greenish with reddish apex, linear, the outer ones 1–1.5 mm, the middle and inner ones 2.5–4 mm long, covered with short, subappressed hairs and sessile glands. Receptacle slightly convex, slightly alveolate. Flowers yellow. Ligulate flowers mostly missing, only in few capitula 2–5, very rarely up to 12, ca. 6 mm long, 1–2 mm longer than the involucrum, female, ligules with three narrowly triangular teeth, densely glandular on outer side. Tubular flowers numerous, hermaphroditic, ca. 5 mm long, in upper part glandular. Achenes cylindric, 1–1.2 mm long, distinctly ribbed, sparsely hairy. Outer pappus scales ca. 0.25 mm long, connate up to the middle, free tips narrow. Inner pappus 8–10 setae, ca. 3 mm long.

Within the subgenus *Pulicaria* the new species is most similar to *P. arabica*. It is easily to distinguish from the latter species by the short and very narrow not sericeous leaves, attenuate but not auricle-like half-clasping the stem, and the distinctly smaller capitula mostly without ligulate marginal flowers.

Scorzonera coronopifolia Desf., Fl. Atlant. 2: 220. tab. 44. 1799.

New to Morocco:

Morocco. Prov. Oujda: 15 km SE Oujda an der Straße S 408 nach Oued El-Heimer, 800 m; Brachacker, steinig-lehmige Flächen, Wiesen [1°57'W, 34°37'N] 8.4.1993, *Förther 6568* (Herb. Förther), *Podlech 51230* (BASBG, MSB).

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Dr. Harald FÖRTHER & Prof. Dr. Dietrich PODLECH, Institut für Systematische Botanik der Ludwig-Maximilians-Universität München, Menzinger Straße 67, D-80638 München, Germany.

Floristic and taxonomic notes on saxicolous lecideoid lichens

H. HERTEL

Abstract:
HERTEL, H.: Floristic and taxonomic notes on saxicolous lecideoid lichens. – Sendtnera 7: 93–136. 2001. ISSN 0944–0178.

(1) *Lecidea lapicida* var. *maungahukae* Hertel (from New Zealand) is described as a new variety. (2) *Carbonea latypizodes* (Nyl.) Knoph & Rambold (syn. *Lecidea latypizodes* Nyl.) is proposed as a new combination. (3) The following taxa are synonyms (correct names in parenthesis): *Lecidea deagostinii* Sambo (= *L. lapicida* var. *pantherina*), *L. squamifera* Stizenb. var. *bylii* Zahlbr. (= *L. capensis*), *L. subsquamifera* Zahlbr. (= *L. terrena*), *L. tolstoii* H.Magn. (= *Farnoldia micropsis*). (4) Lectotypes are chosen for *Lecidea lepadina* Sommerf. and *L. tolstoii* H.Magn. (5) New localities are documented for: *Adelolecia kolaensis* (new to the Southern Hemisphere), *Caloplaca oblongula* (new to Arizona, U.S.A.), *Carbonea atronivea* (new to U.S.A.), *C. phaeostoma* (new to South America), *C. vorticosa* (new to Arizona, California and Washington), *Cecidonia umbonella* (Kavkaz Mts., second record), *Cephalophysis leucospila* (new to U.S.A.), *Clauzadeana macula* (new to Prov. Salzburg, Austria; new to Maine, U.S.A.), *Farnoldia hypocrita* (new to Liechtenstein), *F. micropsis* (Siberia, second record), *Immersaria athroocarpa* (new to Macquarie Island), *I. usbekica* (new to Iran), *Lecanora avium* (new to Prov. Antofagasta, Chile), *Lecidea atromorio* (South Africa), *L. cerviniicola* (Alps, Spain), *L. fuscoatra* (new to South America), *L. fuscoatrula* (New Zealand, South Africa), *L. lapicida* var. *lapicida* (new to Cyprus), *L. leucothallina* var. *kujalae* (new to the Americas), *L. lygomma* var. *lygomma* (new to Africa), *L. plana* (New Zealand, third record), *"Lecidea" polycocca* (Svalbard, second record), *Lecidella pataviana* (new to Argentina), *L. stigmatea* (new to Prov. Mendoza, Argentina), *Miriquidica deusta* (new to U.S.A.), *M. pulvinatula* (new to Iceland), *Poeltiaria corralensis* (new to Prov. Magallanes, Chile), *Poeltidea perusta* (new to Chile), *Rhizocarpon dinothetes* (new to Prov. Salzburg, Austria), *Rimularia insularis* (new to Alaska), *Schaereria fuscocinerea* (new to Africa). (6) Distribution maps are presented for *Carbonea vorticosa* (U.S.A. and adjacent parts of Canada), *Farnoldia micropsis* (Northern Hemisphere), *Lecidea cerviniicola* (Alps), *Lecidella pataviana* (North America), *L. stigmatea* (North America), *Poeltidea perusta* (circum-antarctic regions), *Rimularia insularis* (new to Saskatchewan, Canada), *R. psephota* (Southern Hemisphere), and *Tremolecia atrata* (circum-antarctic regions). (7) Diagrams show the variability of spore size in *Lecidea confluescens*, *L. fuscoatra* and *L. speirodes*, as well as the correlation between altitude and latitude of American collecting sites of *Carbonea vorticosa* (clearly demonstrating its arctic-alpine character).

Zusammenfassung:
(1) *Lecidea lapicida* var. *maungahukae* Hertel var. nov. wird aus dem hochalpinen Bereich Neuseelands beschrieben. (2) Die Kombination *Carbonea latypizodes* (Nyl.) Knoph

& Rambold (syn. *Lecidea latypizodes* Nyl.) wird legalisiert. (3) Als Synonyme werden gewertet (korrekte Namen in Klammern): *Lecidea deagostinii* Sambo (= *L. lapicida* var. *pantherina*), *L. squamifera* Stizenb. var. *bylii* Zahlbr. (= *L. capensis*), *L. subsquamifera* Zahlbr. (= *L. terrena*), *L. tolstoii* H.Magn. (= *Farnoldia micropsis*). (4) Für *Lecidea lepadina* Sommerf. und *L. tolstoi* werden Lectotypen festgelegt. (5) Zahlreiche Neufunde (Details im englischen Abstract) werden mitgeteilt. (6) Verbreitungskarten werden vorgelegt für: *Carbonea vorticosa* (U.S.A. and angrenzendes Kanada), *Farnoldia micropsis* (Nordhalbkugel), *Lecidea cerviniicola* (Alpen), *Lecidella pataviana* (Nordamerika), *L. stigmatea* (Nordamerika), *Poeltidea perusta* (Gesamtareal), *Rimularia psephota* (Südhemisphäre) und *Tremolecia atrata* (Subantarktis). (7) Diagramme zeigen die Variabilität der Größe der Ascosporen von *Lecidea confluescens, L. fuscoatra* und *L. speirodes* sowie die Abhängigkeit der geographischen und der Höhenverbreitung bei den amerikanischen Vorkommen von *Carbonea vorticosa* (wobei der ausgeprägt arktisch-alpine Charakter der Art deutlich sichtbar wird).

Introduction

Noteworthy floristic and taxonomic data on saxicolous lecideoid lichens are presented here. Besides information on rarely collected taxa, we also include records of those more common species, which were often misunderstood. Citation of collecting localities follows the original spelling given on the labels. Additions made by the author are given in square brackets.

New records cited below are generally based on undetermined or incorrectly determined specimens, deposited in the Botanische Staatssammlung München (M) or from the herbaria ASU, B, BCC, CANL, CANU, COLO, FI, G, GZU, H, LD, MICH, MIN, MSC, O, S, STU, UPS, W, and WIS (acronyms following HOLMGREN et al. 1990). I would like to thank the directors and curators of these herbaria for supplying the material on loan.

The taxa

Adelolecia kolaensis (Nyl.) Hertel & Rambold

HERTEL & RAMBOLD, Bibl. Lichenol. 57: 214–221 (1995) ≡ *Lecidea kolaensis* Nyl., Flora 46: 306 (1863).

= *Lecidea conferenda* Nyl., Flora 49: 418 (1866).

New record:

Chile. XII Región de Magallanes y de la Antártica Chilena. Prov. de Magallanes: Punta Arenas, Cerros Mina Rica, on stones in naked mineral-soil (solifluction), 550 m, 4.3.1941, *Santesson 6144* (S).

New to the Southern Hemisphere. *Adelolecia kolaensis* is known from cool and cold temperate regions of Europe, Greenland, and Colorado, U.S.A. (HERTEL & RAMBOLD 1995).

Adelolecia pilati (Hepp) Hertel & Hafellner

HERTEL & HAFELLNER in HAFELLNER, Beih. Nova Hedwigia 79: 260 (1984); HERTEL & RAMBOLD, Bibl. Lichenol. 57: 221–227 (1995); THOMSON, American Arctic Lichens 2: 36–38 (1997) ≡ *Lecidea pilati* (Hepp) Körb., Parerga Lichenol. : 223 (1861).

New records:

Svalbard. Spitsbergen: Kongsfjord, Blomstrandhalvøya, Gipfelbereich des Berges Bratliektoppen [78°59'N, 12°05'E], an lose am Boden liegendem Schieferstein, 369 m, 22.7.1975, *Hertel 16297 & Ullrich* (M). Reported from Svalbard from the Icefjord area (HERTEL 1977a, HERTEL & RAMBOLD 1995), and West Station (PAULSON 1928; unconfirmed record; material not found in BM).

Austria. Kärnten: Maltatal, Pflüglhof-Klampfereralm [46°59'N, 13°27'E], am Weg im Wald auf Gneis, 1600 m, 26.7.1931, *Frey* (G). – Already known from Kärnten (HERTEL & RAMBOLD 1995).

Amygdalaria elegantior (H.Magn.) Hertel & Brodo

HERTEL & BRODO in BRODO & HERTEL, Herzogia 7: 506–508 (1987); THOMSON, American Arctic Lichens 2: 40–41 (1997).

New record:

U.S.A. Alaska: Ridge above Okpilak Lake, 69°23'N, 144°05'W, 975 m, 15.8.1957, *Cantlon & Gillis 57-2212* (MSC). Already known from Alaska (THOMSON 1997, TALBOT & al. 1997).

Amygdalaria panaeola (Ach.) Hertel & Brodo

HERTEL & BRODO in BRODO & HERTEL, Herzogia 7: 510–511 (1987); THOMSON, American Arctic Lichens 2: 40, 42 (1997).

New records:

Canada. British Columbia: 37 miles E of Terrace along Highway 16, 54°51'N, 128°21'W, 215 m, 3.8. 1970, *Ohlsson 2883* (MSC) – Mt. Cain, just north of Schoen Lake [50°12'N, 126°19'W], on exposed rock above timberline, 1800 m, 9.8.1969, *Ohlsson 1594* (MSC). Mentioned for British Columbia by NOBLE & al. (1987).

U.S.A. Alaska: Ca. 40 miles E of Cape Lisburne, 0.5 miles from coast, W of Pitmegea River, [68°53' N, 164°41'W], below crest of windswept ridge with barrens vegetation, less than 100 ft, 25.6.1957, *Cantlon & Gillis 57-170* (MSC). Already known from Alaska (THOMSON 1997, TALBOT & al. 1997).

Amygdalaria pelobotryon (Wahlenb. in Ach.) Norman

NORMAN, Nyt Mag. Naturvid. 7: 230 (1853); INOUE, J. Hattori Bot. Lab. 56: 326–328 (1984); BRODO & HERTEL, Herzogia 7: 511–513 (1987); THOMSON, American Arctic Lichens 2: 42–44 (1997); MAKAROVA in ANDREEV, KOTLOV & MAKAROVA, Handbook Lichens Russia 7: 124–125 (1998).

New records:

Ireland. South Kerry (H1), Dingle Peninsula: Windverblasener Sattel am Ballysitteragh, NE von Dingle, ca. 600 m, 24.7.1963, *Leuze & Doppelbaur 10882* (M). – Already known from South Kerry (SEAWARD 1984).

U.S.A. Alaska: Vicinity of Juneau, Mt. Roberts Trail [58°17'N, 134°20'W], ca. 1070 m, in low alpine zone, 4.7.1962, *Imshaug 28212* (MSC). Already known from Alaska (TALBOT & al. 1991, THOMSON 1997, TALBOT & al. 1997).

Caloplaca oblongula (H.Magn.) Wetmore

WETMORE, Mycologia 86: 828 (1994) ≡ *Lecidea oblongula* H.Magn., Acta Horti Gothob. 19: 37 (1952) ≡ *"Caloplaca oblongula"* in HERTEL, Herzogia 3: 367–369, 370 (1975) ≡ *Apatoplaca oblongula* (H.Magn.) Poelt & Hafellner, Mitt. Bot. Staatssamml. München 16: 507 (1980); BELLEMÈRE, HAFELLNER & LETROUIT-GALINOU, Cryptog. Bryol. Lichénol. 7(3): 189–211 (1986; on ultrastructure).

New record:

U.S.A. Arizona, Coconino Co.: Echo Cliffs, 10 miles SSW of Page [36°55'N, 111°28'W], along U.S. 89, ca. 1500 m, on sandstone, 23.4.1973, *Nash 6546* (ASU).

This record corresponds closely in morphological and anatomical characters with the holotype of the taxon (as described and figured by HERTEL 1975c). *Caloplaca oblongula* is based on a collection from Utah. WETMORE (1994) gives an additional record from Colorado.

Because of its often unicellular spores, the taxon may be erroneously considered as a species of *Fuscidea* which shares some ascal and gross morphological characters. However, *Caloplaca oblongula*, has a K+ violet epihymenium and excipular cortex and prefers semiarid sites, while *Fuscidea* is a genus restricted to humid climates.

Carbonea atronivea (Arnold) Hertel

HERTEL, Mitt. Bot. Staatssamml. München 19: 442 (1983); THOMSON, American Arctic Lichens 2: 191 (1997) ≡ *Lecidea atronivea* Arnold, Flora 53: 123 (1870); HERTEL, Beih. Nova Hedwigia 24: 101–104 (1967); HERTEL, Herzogia 1: 33 (1968), 2: 39 (1970), 2: 232 (1971), 2: 484 (1973), 3: 375 (1975).

New records:

Switzerland. Kanton Glarus: Ziger, 47°04'N, 9°15'E, nördlich oberhalb Unterterzen, 2050 m, 27.9. 1972, *Hertel 15867* (M).

Italy. Prov. Belluno: Marmolada-Gruppe, Ombretta-Pass [46°29'N, 11°51'E], ca. 2700 m, VIII.1968, *Wunder 802* (M).

France. Dépt. Hautes Alpes: Aiguille de Chambeyron [44°32'N, 6°51'E], NE oberhalb St. Paul, am Col de Vars, 3300 m, 11.9.1996, *Schauer* (M).

U.S.A. Montana: Glacier Co., Glacier National Park, Siyeh Pass [48°43'N, 113°38'W], 2500 m, 17.8. 1950, *Imshaug 9027* (MSC – a small thallus beside *Lecidella pataviana*) – Glacier National Park, Dawson Pass [48°29'N, 113°28'W], 7500–8000 ft, 13.8.1950, *Imshaug 8649* (MSC). New to U.S.A.

This well-named taxon (with small black and shiny apothecia on a chalky snow-white thallus) is strictly calciphilous. Its distribution in the Alps is mapped by HERTEL (1967), and its general distribution is outlined by HERTEL (1975c). Remarkable additional records are reported by CLAUZADE & ROUX (1974), KILIAS (1978, Picos de Europa, Spain), PORYADINA (1998, Yakutia), and TÜRK & WUNDER (1999).

Carbonea latypizodes (Nyl.) Knoph & Rambold comb. nov.

Basionym: *Lecidea latypizodes* Nyl., Flora 57: 12 (1874).

= *Carbonea montevidensis* (Müll.Arg.) Rambold & Knoph in RAMBOLD, Bibl. Lichenol. 34: 79–82 (1989).

New records:

Argentina. Prov. Tucumán: Valle de Tafí, Carapunco-Infiernillo, 2800 m, schistose rock, 19.11.1947, *Lamb 5192* (UPS), and 23.9.1947, *Lamb 5390* (UPS; both specimens contain atranorin and 2'-O-methylperlatolic acid). – Previously reported from Argentina by OSORIO (1987).

Carbonea phaeostoma (Nyl.) Hertel

HERTEL, Lecideac. Exs., fasc. VI, no. 103 (1984); HERTEL, Beih. Nova Hedwigia 79: 443–444 (1984); HERTEL, Mitt. Bot. Staatssamml. München 21: 304–306 (1985), 23: 324–325 (1987), 28: 215 (1989).

New records:

Argentina. Isla de los Estados: Puerto Vancouver, 54°47'S, 64°04'W, littoral zone at point on E side of bay, 28.10.1971, *Imshaug & Ohlsson 52054, 52057, 52093* (MSC) – Puerto Basil Hall, littoral zone at Punta Passalacqua, N of Pto Abrigado, 54°45'S, 64°10'W, 22.10.1971, *Imshaug & Ohlsson 51345* (MSC) – Puerto San Juan, on slope of Punta Lasserre facing entrance to bay, 54°44'S, 63°52'W, 26.10. 1971, *Imshaug & Ohlsson 51958* (MSC). New to South America.

Falkland Islands (= **Islas Malvinas**). West Falklands: Port Philomel, Halfway Cove [ca. 51°43'S, 60°25'W], on sandstone, 22.11.1907, *Skottsberg s.n.* (UPS, beside *"Lecidea elatizans"*).

Îles de Kerguélen. Péninsule Courbet, sheltered cliffs near summit of Pointe Molloy, 50–100 m, 16. 2.1971, *Imshaug 48306, 48310* (MSC) – Halage des Swains (vicinity), sea coast and base of cliffs on shore opposite Ile Richard-Foy, 26.2.1971, *Imshaug 48676* (MSC).

Auckland Islands. Auckland Island: Littoral zone S side of inner part of Musgrave Inlet, 19.12.1972, *Imshaug 56589* (MSC) – NW end of North Arm, Carnley Harbour, north of Figure of Eight Island, 28. 12.1972, *Imshaug 57031* (MSC) – Forest with bryophyte cover and tree ferns, south side near head of bay, McLennan Inlet, 31.12.1972, *Imshaug 57179, 57194* (MSC) – South side of Crozier Point peninsula, 25.12.1972, *Imshaug 56841, 56843* (MSC).

Carbonea phaeostoma shows a circumantarctic distribution, being known from New Zealand and its subantarctic islands, and from Macquarie Island, Heard Island, Îles de Kerguélen, and

Prince Edward Islands (mapped by HERTEL 1987).

Carbonea vorticosa (Flörke) Hertel

HERTEL, Mitt. Bot. Staatssamml. München 19: 442 (1983); 21: 306–308 (1985); 28: 215–216 (1989); 30: 300–301 (1991); RAMBOLD, Bibl. Lichenol. 34: 83–88 (1989); THOMSON, American Arctic Lichens 2: 192–193 (1997) ≡ *Lecidea vorticosa* (Flörke) Körb.; HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 316–317 (1977).

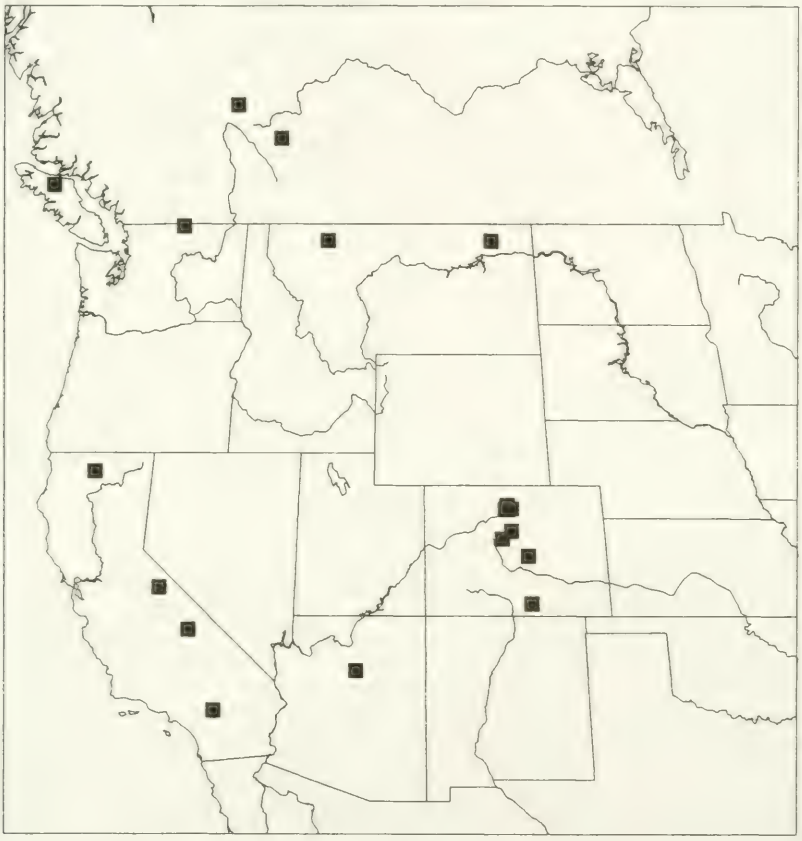

Figure 1: *Carbonea vorticosa* in non-arctic North America. The species is restricted to alpine stands (see fig. 2). Map based on studied specimens.

New records:

Svalbard. Spitsbergen: Isfjord, Bolterdalen [78°08'N, 16°00'E; ca. 170 m], 4.8.1975, *Hertel 17236 & Ullrich* (M) – Kongsfjord, Blomstrandhalvøya, Gipfelbereich des Bratliektoppen [78°59'N, 12°05'E], 365 m, 22.7.1975, *Hertel 16299 & Ullrich* (M).

Austria. Tirol: Kaunergrat, Gipfel der Watzespitze [46°59'N, 10°48'E], 3530 m, VIII.1953, *Poelt* (M, filed under *Lecidea atrobrunnea*).

Switzerland. Kanton Graubünden: Unterengadin, Piz Linard [46°48'N, 10°04'E], Gipfelgrat, 3350 m, an Gneis-Platten, 4.8.1945, *Frey 28229* (G) – Sesvenna, Großer Block an der Moräne des Gletschers, 2650 m, 5.9.1929, *Frey 515* (G). – Kanton Wallis: Zermatt, Gornergrat, Rotboden bei der Bergstation

[45°59'N, 7°46'E], aus dem Curvuletum aufragende Grünschiefer-Felsrippen, 2780–2800 m, 21.7.1961, *Frey 27228* (G) – Plateau du Trient, Pointe d'Orny, Arête SE, 3250 m, 30.7.1946, *Frey 1672* (G) – Val d'Herens, Sasseneire [46°08'N, 7°32'E], Gipfelgrat, 3250 m, 31.7.1929, *Frey 420/1* (M) – Unteres Findelenrothorn [46°01'N, 7°48'E], 3000 m?, 29.7.1922, *Schroeter* (G).

Greenland. N.E. Greenland: Fligely near Kuhn Ø., 74°49'N, 20°45'W, 28.7.1988, *Hansen* (M, Lich. Groenl. Exs. 347; tiny accompanist of *Sporastatia testudinea*).

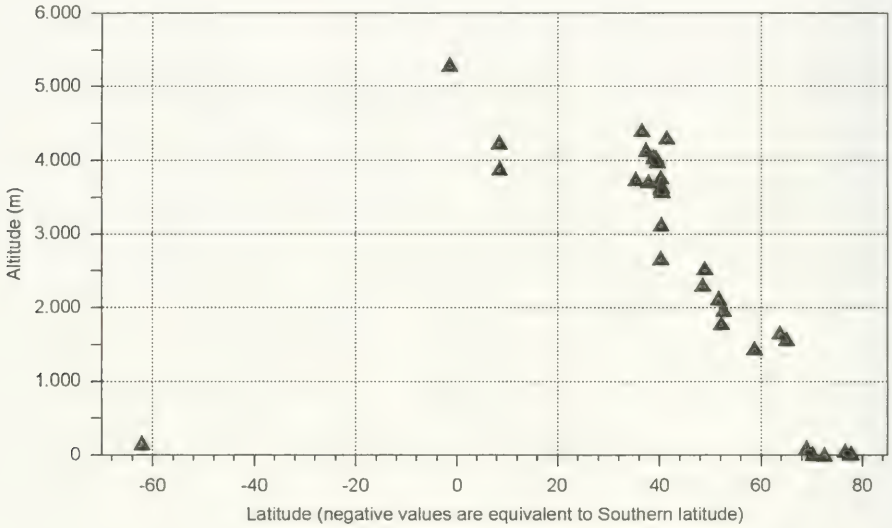

Figure 2: *Carbonea vorticosa*: Correlation between altitude and latitude of collecting localities in North and South America and adjacent parts of Antarctica. Note, that *Carbonea vorticosa* is restricted to localities of the alpine belt. Low altitude literature records given for U.S.A. most likely are based on misidentifications.

Canada. Alberta: Jasper National Park: Ridge opposite Angel Glacier on Mt. Edith Cavell, [52°38'N, 118°06'W], 1980 m, 16.–17.7.1950, *Imshaug 6993, 7047* (MSC, beside *Lecidea lapicida* var. *pantherina* and *Tremolecia atrata*). – British Columbia: Mt. Cain just N of Schoen Lake, 50°12'N, 126°19'W, 1800 m, just above timberline on exposed rock, 9.8.1969, *Ohlsson 1579* (MSC).

U.S.A. Alaska: Juneau Icefield, summit of ridge on mountain above Camp 10 and above névé of Taku Glacier at 4800 ft [= 1460 m] elevation, 58°42'N, 134°13'W, 19.7.1962, *Imshaug 28917* (MSC – small thalli beside *Rhizocarpon* sp.). – Arizona: Coconino Co., summit of Agassiz Peak [35°19'N, 111° 40'W], San Francisco Mts., 3760 m, 7.7.1955, *Imshaug 17902* (MSC). – California: San Bernardino Co., San Bernardino Mts., summit of San Gorgonio Mt. [34°06'N, 116°50'W], 3500 m, 27.6.1955, *Imshaug 17785* (MSC, beside *Lecidea atrobrunnea*), *17983b* (MSC) – Siskiyou Co., summit of Mt. Shasta, southern Cascade Mts., 41°25'N, [122°18'W], 4317 m, 29.7.1955, *Imshaug 18339* (MSC) – Tulare Co., Sierra Nevada, summit of Mt. Whitney, 36°35'N, [118°00'W], 4418 m, 11.7.1955, *Imshaug 17983b* (MSC), *Imshaug 17991* (MSC, beside *Lecidea atrobrunnea*) – Tuolumne Co., summit of Mammoth Peak, 37°52'N, [119°15'W], Sierra Nevada, 3726 m, 20.7.1955, *Imshaug 18207b* (MSC). – Colorado: Clear Creek Co., wet meadow on Mt. Evans, Front Range, 39°36'N, [105°38'W], 3990 m, 15.7.1952, *Imshaug 11115* (MSC) – El Paso Co., Pikes Peak, Front Range, 38°50'N, [105°02'W], 4055 m, 4.8.1952, *Imshaug 11964* (MSC) – Larimer Co., dry meadow along Trail Ridge Road, Front Range, Rocky Mt. National Park, 40° 24'N, 3660 m, 16.7.1952, *Imshaug 11202* (MSC) – Summit Co./Park Co., Hoosier Ridge, 39°22'N, [106° 00'W], 4050 m, 8.7.1956, *Imshaug 19054* (MSC) – Summit of West Spanish Peak, Sangre de Cristo

Range, 37°23'N, [104°59'W], 4152 m, 6.8.1952, *Imshaug 12057* (MSC). Already reported from Colorado by ANDERSON (1964). – Montana: Glacier National Park, Scenic Point [48°29'N, 113°19'W], 2320 m, 15. 8.1950, *Imshaug 8868* (MSC). – Washington: Okanogan Co., summit of Windy Peak, 48°55'N, [119°58' W], Northern Cascade Mts., 2543 m, 17.8.1995, *Imshaug 18685* (MSC).

Already reported for Alberta by ANDERSON (1964), for British Columbia by NOBLE & al. (1987), for Alaska by e.g. THOMSON (1997), for Arizona by FINK (1935 – no additional records mentioned in NASH & JOHNSEN's catalogue 1975), for California by HASSE (1913 – no additional records mentioned in TUCKER & JORDAN's catalogue 1979), for Colorado by ANDERSON (1964), for Montana by DEBOLT & MCCUNE (1993), for Washington by THOMSON (1969 – based upon HOWARD 1950). However, these old records for Arizona, California, Washington (as well as those for New Mexico by RUDOLPH 1953) are rather doubtful (see also ANDERSON 1964). *Carbonea vorticosa* is an oreophyte with a world-wide distribution (mapped by HERTEL 1985) and restricted to high altitudes and/or high latitudes (as fig. 2 clearly shows). In Himalaya *Carbonea vorticosa* is found up to an altitude of 7400 m (HERTEL 1977c), in the Andes up to 5300 m (HERTEL 1971b) in the Alps up to 4000 m (HERTEL 1970), in Japan up to 3750 m (HERTEL 1977c), and in New Zealand up to 2955 m (HERTEL 1989). It is incredible that this taxon occurs at altitude of only 1600 m in California HASSE 1913), or 1890 m in New Mexico (RUDOLPH 1953).

Cecidonia umbonella (Nyl.) Triebel & Rambold

TRIEBEL & RAMBOLD, Nova Hedwigia 47: 284 (1988); TRIEBEL, Bibl. Lichenol. 35: 131–132 (1989); HAFELLNER, Herzogia 8: 367–368 (1990); HERTEL, Mitt. Bot. Staatssamml. München 30: 301 (1991); WIRTH, Flechten Baden-Württembergs 1: 263 (1995; macrophoto!); INOUE, Bull. Nation. Sci. Mus., Tokyo, ser. B, 23(2): 45–46 (1997).

New records:

Sweden. Jämtland: Skurdalsporten, 26.6.1914, *Magnusson* (W, on thallus of *Lecidea praenubila* Nyl.). *Cecidonia umbonella* is rather common in Scandinavia (see map in TRIEBEL & RAMBOLD 1988). It mainly colonises thalli of *Lecidea lapicida*. By contrast, *Lecidea praenubila* is a very rare host of this cecidiogenous lichenicolous species with only one published record (Sweden: Torne Lappmark – see TRIEBEL & RAMBOLD 1988).

Russia. Respublika Kabardino-Balkaria: Caucasus Centralis, distr. Tyrnyauz, Regio Mons Elbrus, vicinitatis lacus Donguzorumkoel, in declivibus occid. montis Cheget, 2400–2600 m, 20.6.1980, *Vašák* s.n. (M; on *Lecidea lapicida* var. *pantherina*). – From the Kavkaz Mts. *Cecidonia umbonella* is known only by a single report from Northern Osetia (TRIEBEL & RAMBOLD 1988).

Cephalophysis leucospila (Anzi) Kilias & Scheidegger

KILIAS & SCHEIDEGGER in KILIAS, Herzogia 7: 183 (1985); HERTEL, Mitt. Bot. Staatssamml. München 30: 301–302 (1991); THOMSON, American Arctic Lichens 2: 203–204 (1997).

= *Lecidea ultima* Th.Fr. – Th.FRIES, J. Linn. Soc. London (Bot.) 17: 363 (1879); HERTEL, Beih. Nova Hedwigia 24: 107–110 (1967); HERTEL, Herzogia 1: 36 (1968), 2: 51 (1970), 2: 249–250 (1971), 2: 496–497 (1973), 4: 387 (1977), 5: 458 (1981); HERTEL, Mitt. Bot. Staatssamml. München 12: 136–140 (1975).

New records:

Austria. Tirol: Lechtaler Alpen, Kaiserjoch [47°10'N, 10°20'E], 2300 m, oberhalb Pettneu im Stanzer Tal, VIII.1892, *Arnold* (M). – This record was published as "*Lecidea paraphana* Nyl. var. ...." [sic!] by ARNOLD (1893).

France. Dépt. Hautes Alpes: Aiguille de Chambeyron [44°32'N, 6°51'E], NE oberhalb St. Paul, am Col de Vars, 3300 m, 11.9.1996, *Schauer* (M).

U.S.A. Colorado: Virginia Basin, Elk Mts., 38°59'N, [106°58'W], 3660 m, 5.7.1952, *Imshaug 10616* (MSC) – Gunnison Co., summit ridge of White Rock Mt., Elk Mts., 38°59'N, 3900 m, 13.7.1952, *Imshaug 10947* (MSC) – Summit/Park Co., Hoosier Ridge, Park Range, 39°22'N, [106°00'W], 3960 m, 8.8.

1956, *Imshaug 18961* (MSC; a small cryptothalline thallus beside *Glypholecia scabra* (Pers.) Müll.Arg.). New to U.S.A.

Cephalophysis leucospila is a tiny, arctic-alpine, calcicolous species. Its holarctic distribution is mapped by HERTEL (1975b), that in the Alps by HERTEL (1967 and 1971a) and that in North America by THOMSON (1997). ANDREEV & KUDRATOV (1992) reported it from the Gissarskij Mountains of Tadzhikistan. Additional records for France and Spain are given by KILIAS (1978), ROUX (1983), NAVARRO-ROSINÉS & HLADUN (1991– specimen seen in BCC-Lich), and BOOM et al. (1995). In North America hitherto only records from the Arctic were known.

Clauzadeana macula (Taylor) Coppins & Rambold

COPPINS & RAMBOLD in RAMBOLD, Bibl. Lichenol. 34: 85 (1989); HERTEL, Mitt. Bot. Staatssamml. München 30: 302–303 (1991).

= *Lecanora morioides* (Arnold) Blomb., Bot. Not. 1895: 96 (1895); THOMSON, American Arctic Lichens 2: 293–294 (1997).

New records:

Austria. Salzburg: Radstätter Tauern, Mt. Wurmwand, north of the village Obertauern, SE ridge, above the pass Seekarscharte, 47°16'N, 13°34'E, ca. 2100 m, on *Protoparmelia badia*, 14.8.1994, *Hertel 38259* (M). – Not mentioned in TÜRK & WITTMANN's (1987) catalogue of the lichens of Salzburg.

Russia. E. Chukotka: Gilimimliveen River, near hot source, on cobble, 31.07.1977, *Makarova s.n.* (M, accompanist of *Sporastatia testudinea*).

U.S.A. Maine: Hanock Co., Acadia National Park, Mt. Desert Island, around peak of Cadillac Mountain, on rock outcrops and in stunted spruce forest, 17.6.1983, *Wetmore 45753* (MIN) – Mt. Desert Island, in gorge south of saddle between Cadillac and Dorr Mts, in birch, oak and young spruce woods with rock boulders along sides, 21.7.1984, *Sullivan 4357* (MIN), *4368* (MIN) – Desert Island, Long Pond south of Duck Rock (N–NE of Mansell Mt.), in *Thuja*, maple, spruce, and birch woods with rock outcrops and along shore and talus slope, 1.7.1985, *Sullivan 5248* (MIN). New to Maine.

The taxon was hitherto known only from Europe, Japan, North America (Colorado), and Australia (summarized by RAMBOLD 1989). HERTEL (1989) added records from New Zealand, ANDREEV & ANTONOVA (1989) from Kola Peninsula (Russia), HERTEL (1992) from Canada (N.W.T.), ANDREEV & MYRZAKULOVA (1992) from Kazachstan, KOTLOV (1995) from Eastern Siberia, and TALBOT & al. (1997) from Alaska.

Farnoldia hypocrita (A.Massal.) Fröberg

FRÖBERG, The calcicolous lichens on the Great Alvar of Öland, Sweden (Lund): 57–59 (1989); MAKAROVA in ANDREEV, KOTLOV & MAKAROVA, Handbook Lichens Russia 7: 135–136 (1998) ≡ *Lecidea hypocrita* ["*ypocrita*"] A.Massal., Symmicta Lich. Nov. 54 (1855); HERTEL, Beih. Nova Hedwigia 24: 69–74 (1967); HERTEL, Herzogia 2: 485–487 (1973 – with distribution map); THOMSON, American Arctic Lichens 2: 352–353 (1997).

New records:

Austria. Salzburg: Steinernes Meer, zwischen P. 2052 und P. 2018 nördlich der Schönfeldgrube [47° 28'N, 12°57'E], MTB 8543/2, 11.8.1987, *Schuhwerk 2015* (M).

Liechtenstein. Am Fürstensteig, zwischen Alpspitz und Gafleispitz [47°10'N, 9°33'E], nördlich von Schaan, ca. 1900 m, auf Kalkfelsen (beside *Farnoldia jurana* (Schaer.) Hertel), 25.9.1972, *Hertel 12811* (M). – Not recorded for Liechtenstein by DALLA TORRE & SARNTHEIN (1902), or by HERTEL (1967), who mapped the distribution of *Farnoldia hypocrita* in the Alps.

Italy. Prov. Bozen: Am Karersee [= Karrersee, 46°25'N, 11°34'E] in den Dolomiten, 1954, *E. Schmid* (M).

Farnoldia micropsis (A.Massal.) Hertel

HERTEL, Mitt. Bot. Staatssamml. München 19: 443 (1983), 28: 216–217 (1989), 30: 304 (1991); THOMSON, American Arctic Lichens 2: 226–227 (1997); MAKAROVA in ANDREEV, KOTLOV

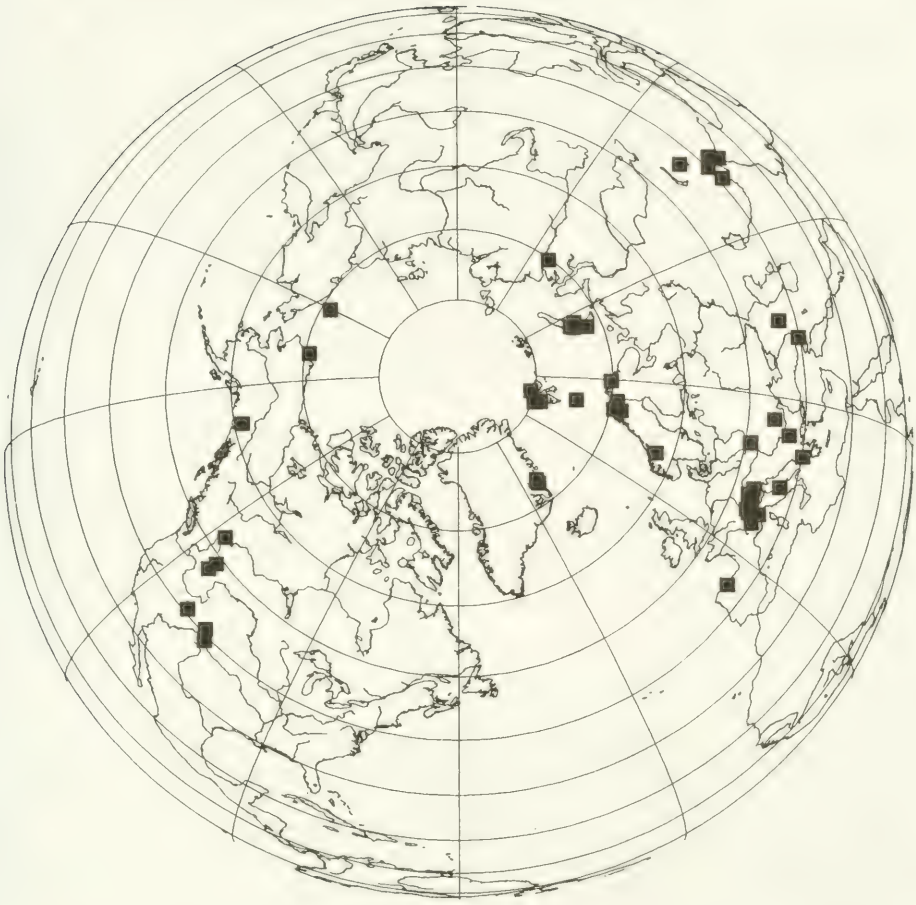

Figure 3: Holarctic distribution of *Farnoldia micropsis*, a bipolar, calciphilous species. (Based on specimens studied by the author.)

& MAKAROVA, Handbook Lichens Russia 7: 135–136 (1998) ≡ *Lecidea micropsis* A.Massal., Atti I.R. Istit. Ven. Sc., Lett. ed Arti, III (II): 368 (1856) = *Lecidea nivalis* Anzi, Catal. Lich. Sondr. : 82 (1860) = *Lecidea rhaetica* Hepp ex Th.Fr., Lichenes Arctoi : 209 (1860) ≡ *Tremolecia nivalis* (Anzi) Hertel, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 3: 354–356 (1977).

New synonym: *Lecidea tolstoii* H.Magn. – MAGNUSSON, Svensk Bot. Tidskr. 30: 256–257 (1936). – Type: Russia: Guv. Jenisejsk, Tolstoj nos [Tajmyrski (Dolgano-Nenecki) nac. okrug, Tolstyi Nos], 70°10'N [83°15'E], "ad fl. Jenisej", 31.8.1876, *Brenner 1573e* (S, lectotype, selected here).

New records:

Finland. Lapponia enontekiensis: Porojärvet, Toskalharji, Ostteil, auf Dolomit, 750 m, 14.7.1955, *Henssen 914* (M) – Toskalharji, Gipfel, 900 m, auf Kalkgeröll, 4.8.1955, *Henssen 1355* (M).

Turkey. [Prov. Gümüşhane (29):] Ak Dagh [Ak Dağ] inter Erzerum–Trapezunt [40°09'N, 40°37'E], 1914, *Pietschmann* (W). – The record was published by SZATALA (1960) as "*Lecidea rhaetica* Th.Fr. var. *intrusa* J. Steiner". I am indebted to V. JOHN (Bad Dürkheim), who managed – with the help of a recon-

struction of V. Pietschmann's itinerary – to find out, which of the very many Ak Dağs (= White Mountains) in Turkey was the very collecting locality of this species.

Canada. Alberta: Banff National Park: near Upper Victoria Glacier (near Lake Louise), 13.7.1950, *Imshaug 6937b* (MSC). Already reported from Alberta (HERTEL 1973).

U.S.A. Alaska: Along the Kaolak River, south of Wainright, 69°56'N, 159°57'W, on calcareous rock, VII.1958, *Shushan & Maher 10436* (WIS; as *Lecidea crustulata*). – Montana: Glacier National Park, Siyeh Pass [48°43'N, 112°38'W], 2500 m, 17.8.1950, *Imshaug 8982* (MSC). From a nearby locality in Alaska previously recorded by HERTEL (1991). Non-arctic U.S.A. records are from Colorado (ANDERSON & CARMER 1974), Montana (HERTEL 1967) and Utah (HERTEL 1975b).

Farnoldia micropsis is a calciphilous arctic-alpine lichen, widespread in the Northern Hemisphere (see map, fig. 3). It is adapted to intermediate rock types and is very rare on pure limestone and dolomite (see HERTEL 1967, table 9). From Siberia there is only one record, from Wrangel Island (DOBRYSH 1995, MAKAROVA 1998).

Fuscidea mollis (Wahlenb.) V.Wirth & Vězda

WIRTH & VĚZDA, Beitr. Naturk. Forsch. Südwest-Deutschl. (Karlsruhe) 31: 92 (1972); HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 197–198 (1977); INOUE, Hikobia suppl. 1: 168–170 (1981); HAFELLNER, Mitt. Naturwiss. Ver. Steiermark 123: 172 (1993); TÜRK, Wiss. Mitt. Nationalpark Hohe Tauern 2: 24 (1996; macrophoto!); THOMSON, American Arctic Lichens 2: 232–233 (1997); BRODO & WIRTH in GLENN, HARRIS, DIRIG, & COLE (eds.): Lichenogr. Thomsoniana: 154–156 (1998).

New record:

Canada. Nunavut: East coast of Hudson Bay, Belcher Islands, on pure quartz ca. 56°11'N, 78°47'W, 27.8.1939, *Marr M-599* (MIN, as *Lecidea atrobrunnea*).

Immersaria athroocarpa (Ach.) Rambold & Pietschmann

RAMBOLD & PIETSCHMANN in RAMBOLD, Bibl. Lichenol. 34: 240 (1989); HERTEL, Mitt. Bot. Staatssamml. München 28: 217–218 (1989), 30: 305–306 (1991); WIRTH, Flechten Baden-Württembergs 2: 771, 772 (1995; macrophotos!); MAKAROVA in ANDREEV, KOTLOV & MAKAROVA, Handbook Lichens Russia 7: 137–138 (1998); CALATAYUD & RAMBOLD, Lichenologist 30: 240 (1998) ≡ *Porpidia athroocarpa* (Ach.) Hertel & Rambold in HERTEL, Lecideac. Exs., fasc. VIII, p. 8 (1985); HERTEL, Mitt. Bot. Staatssamml. München 21: 312–313 (1985) ≡ *Lecidea athroocarpa* (Ach.) Ach.; HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 228–230 (1977); HERTEL & ZHAO, Lichenologist 14: 146 (1982); INOUE, J. Sci. Hiroshima Univ., ser. B, div. 2 (Botany) 18: 22–25 (1982).

New records:

Iceland. Suður Múlasýsla: ca. 1.5 km NW von Djupivogur, 64°40'N, 14°18'W, 20–40 m, 8.7.1979, *Hertel 21509* (M).

Russia. Far East, Chabarovsk Kray: Badzhal Mountain Range (Badzhal'skij Chrebet), upper course of the river Omot, on a stone in the river, 10.7.1981, *Randlane 437* (M).

Nepal. Vorhimalaya: Ostnepal, alpine Matten bei Rauje [Rowuche Teng], ca. 4500 m, IX./X.1962, *Poelt L-1465* (M, extremely eroded specimen). – Khumbu (Mahalangur) Himal: Khumbu, Höhen westlich über Gorak Shep [27°57'N, 86°50'E], 5540 m, IX.1962, *Poelt L-1193* (M). – Previously recorded for Nepal by HERTEL (1977c).

China. Men Tou Gou Distr.: Beijing Forest Ecosystem Research Station, 120 km W of Beijing, on north slopes of Dong Ling Shan, along ridge with few oaks and *Betula platyphylla*, 2250 m, 15.9.1994, *Wetmore 75097* (MIN). – Within China *Immersaria athroocarpa* was reported from the provinces of Yunnan (ZAHLBRUCKNER 1930, HERTEL 1977c) and Jilin (HERTEL & ZHAO 1982); no further records are given in WEI's catalogue (1991).

Canada. Northwest Territories: Mackenzie District, Richardson Mountains, Headwaters of Cache River, 68°10'N, 136°25'W, 22.6.1964, *Thomson 16357* (CANL). – Ontario: Algoma Distr., coast of Lake Superior, Sand Bay [46°44'N, 84°33'W], north of Sault Ste. Marie, on igneous rock along coast, 14.7.

1962, *Henssen & Cain 14211c* (GZU) – Rossport Provincial Campground, 3 miles E of Rossport [48°50'N, 87°31'W], along shore of Lake Superior and on rock ridges back from shore, 4.7.1976, *Wetmore 25028* (MIN) – Slate Islands, Cove Island on S side of Patterson Island, 48°40'N, 87°00'W, rocky small island with a few spruce and shrubs, 27.7.1977, *Wetmore 29681* (CANL, M, MIN).

U.S.A. Minnesota: Cook Co., Susie Islands near Grand Portage, on Long Island along rock shore, 6. 9.1980, *Wetmore 41947* (MIN). – Michigan: Keweenaw Co., Isle Royale National Park, Heron Island [48°08'N, 88°30'W] in Rock Harbor outside of Tookers Isl., 48°09'N, 88°29'W, 26.7.1983, *Wetmore 49547* (M).

Mexico. Veracruz: Cofre de Perote, alpine area below communication installations, by Channel 13 TV Station, ca. 15 km SE Perote, 19°29'N, 97°09'W, alpine vegetation, grassland, ca. 4100 m, 5.3.1995, *Nash 25717* (ASU). *Immersaria athroocarpa* was reported from Mexico (provinces Mexico and Oaxaca) by de LESDAIN (1933).

Subantarctic Islands. Macquarie Island: On rocks between Mount Elder and North Mountain, 7.12. 1968, *D. McVean 6946* (COLO). – New to the subantarctic region. The species is well known from continental Australia (RAMBOLD 1989). #

Immersaria usbekica (Hertel) M. Barbero, Nav.-Ros. & Cl. Roux

BARBERO, NAVARRO-ROSINÉS & ROUX, Bull. Soc. Linn. Provence 41: 139–142 (1990); MAKAROVA in ANDREEV, KOTLOV & MAKAROVA, Handbook Lichens Russia 7: 137–138 (1998) ≡ *Lecidea usbekica* Hertel, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 288–290 (1977).

= *Amygdalaria tellensis* Esnault & Cl. Roux. – ESNAULT & ROUX, Anal. Jardin Bot. Madrid 44 (11): 212–224 (1987).

New record:

Iran. [Prov. Markazi]: Mowdere-Berg bei Sultanabad [= Arak, 34°05'N, 49°42'E], [1905–1906], *Strauss* (W). – An almost sterile collection with many graphidioid pycnidia (pycnospores bacilliform, 6 – 8.5 × ± 1 μm) and gryophoric acid and O-methylgyrophoric acid (chem. det. Ch. Leuckert, Berlin) as lichen substances, growing on slightly calcareous rock. STEINER (1910) published it as *Lecidea atrobrunnea* and SZATALA (1957) repeats these data in his catalogue of the lichens from Iran.

Immersaria usbekica is known from Uzbekistan and Kazakhstan (HERTEL 1977a), Tadzhikistan (ANDREEV & BAIBULATOVA 1985), Algeria (ESNAULT & ROUX 1987), and Spain (BARBERO & al. 1990). – New to Iran.

Lecanora avium (Zahlbr.) Hertel

HERTEL, Beih. Nova Hedwigia 79: 447, 475 (1984) ≡ *Lecidea avium* Zahlbr. in SKOTTSBERG, Nat. Hist. Juan Fernandez 2: 357–358 (1924).

= *Lecidea chilena* Zahlbr., Catal. Lich. Univ. 3: 533 (1925), nom. nov. pro *Lecidea aeruginosa* Nyl., Annal. Sci. Nat. Bot., ser. 4, 3: 164 (1855) nom. illegit.

New record:

Chile. **II Región de Antofagasta**. Prov. de Antofagasta: Cerro Moreno [23°26'S, 70°24'W], rocas costoneras [granite], 10 m, 1965, *Follmann 16536* (M; a small thallus beside isotype of *Arthothelium pacificum* Follmann).

Formerly, *Lecanora avium* was known only from the Juan Fernandez Islands and from the Chilean province of Coquimbo (HERTEL 1984).

Lecidea atromorio C. Knight

KNIGHT, Trans. Proc. New Zealand Inst. 8: 315–316 (1876); HERTEL, Mitt. Bot. Staatssamml. München 21: 321–322 (1985), 28: 219 (1989); RAMBOLD, Bibl. Lichenol. 34: 165–167 (1989).

New records:

South Africa. Eastern Cape Prov., Ciskei: Second Hogsback Mountain, north of Alice, 32°36'S, 27° 00'E, 1580–1780 m, 1.6.1982, *Hertel 24972, 24974* (M).

New Zealand. Wellington: Cape Palliser Road ca. 13 km north of Ngawihi, 41°29'S, 175°13'E, rock outcrops near the sea, 18.8.1992, *Mayrhofer 10852 & Hierzer* (GZU). – Marlborough: NE of Kaikoura, Ohau Stream north of Ohau Point, 42°14'S, 173°50'E, 31.8.1992, *Mayrhofer 12187 & Meurk* (GZU) – Goose Bay SW of Kaikoura, coastal rocks, 42°28'S, 173°32'E, 1.9.1993, *Mayrhofer 12148 & Meurk* (GZU). – Otago: Clutha River Valley, 1 km SE of Roxburgh East, near Roxburgh [45°33'S, 169°18'E], ca. 100 m, schist outcrops at a steep sunny slope, 1.2.1985, *Hertel 30157 & Mayrhofer* (M).

Lecidea atromorio was first described from New Zealand, where it is apparently widespread (HERTEL 1985, 1989). It is reported also from continental Australia (RAMBOLD 1989), Tasmania (HERTEL 1989), and South Africa (RAMBOLD 1989; no localities given).

Lecidea auriculata Th.Fr.

FRIES, Lichenes Arctoi: 213 (1860); HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 233–234 (1977); HERTEL, Mitt. Bot. Staatssamml. München 13: 339–342 (1977), 28: 219–220 (1989), 30: 306–307 (1991); INOUE, J. Sci. Hiroshima Univ., ser. B, div. 2 (Botany) 18: 26–28 (1982); HERTEL, Bibl. Lichenol. 58: 154–155 (1995); HERTEL, Symb. Bot. Upsal. 32(1): 99–100 (1997); THOMSON, American Arctic Lichens 2: 328–330 (1997); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 27–29 (1998).

New records:

Austria. Tirol: Osttirol, Granatspitz-Gruppe, Südkamm des Nussingkogels, Kante eines Überhangdaches beim Trugenköpfl [47°03'N, 12°33'E], 2620 m, 30.8.1988, *Schuhwerk 2219* (M). – Kärnten: Kreuzeck-Gruppe, Knotenberg [46°47'N, 13°07'E] bei Greifenburg, 2180–2215 m, 15.7.1978, *Wirth 6310* (STU).

Switzerland. Kanton Wallis: Rothhorn [46°01'N, 7°49'E], au dessus du Zermatt, 1854, *DeCandolle* (G–DC, as *Lecidea pilati*).

Italy. Prov. Bozen: Vordere Schöntaufspitze [46°30'N, 10°37'E] SE von Innersulden, 2400 m, Überhangfläche, 27.7.1970, *Hertel 11491* (M).

France. Dépt. Hautes Alpes: Col de Granon [44°57'N, 6°37'E], NNW Briançon, 2350 m, 11.7.1970, *Hertel 11580* (M).

Russia. Respublika Kabardino-Balkaria: Caucasus Centralis, distr. Tyrnyauz, Regio montis Elbrus, in vicinitate glaciei Shelda, in valle fluminis Shelda, 2100–2300 m, 29.7.1981, *Vašák* (M).

Canada. Northwest Territories: [Mackenzie district]: Unnamed tributary of the Arctic Red River, entering from the E side [ca. 65°45'N, 131°30'W], ca. 120 miles WNW of Norman Wells, on boulders, 4.8. 1978, *Bird & Thomson 19880* (M). – Nunavut: Ellesmere Island, Goose Fjord [76°24'N, 88°19'W], 0–100 ft, *Innes-Taylor 74* (CANL).

Lecidea auriculata is a bipolar, arctic-alpine species. It is common only in the Arctic. A high percentage of the older herbarium specimens are misidentified. Its Northern Hemisphere distribution was mapped by HERTEL (1977b), the arctic American one by THOMSON (1997) and that of Japan by INOUE (1994).

Lecidea capensis Zahlbr.

ZAHLBRUCKNER, Catal. Lich. Univ. 3: 6345 (1925); RAMBOLD, Bibl. Lichenol. 34: 168–172 (1989).

New synonym:

Lecidea squamifera Stizenb. var. *bylii* Zahlbr. Annal. Crypt. Exot. 5: 231 (1932). – Type: Republic of South Africa, Kapland [Northern Cape Prov.], Calvinia [31°28'S, 19°46'E], [no date], *van der Byl 772* (W, holotype).

Lecidea cerviniicola de Lesd.

DE LESDAIN, Bull. Soc. Bot. France 102: 231 (1955); HERTEL, Decheniana 127: 63 (1975); HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 241 (1977); RAM-

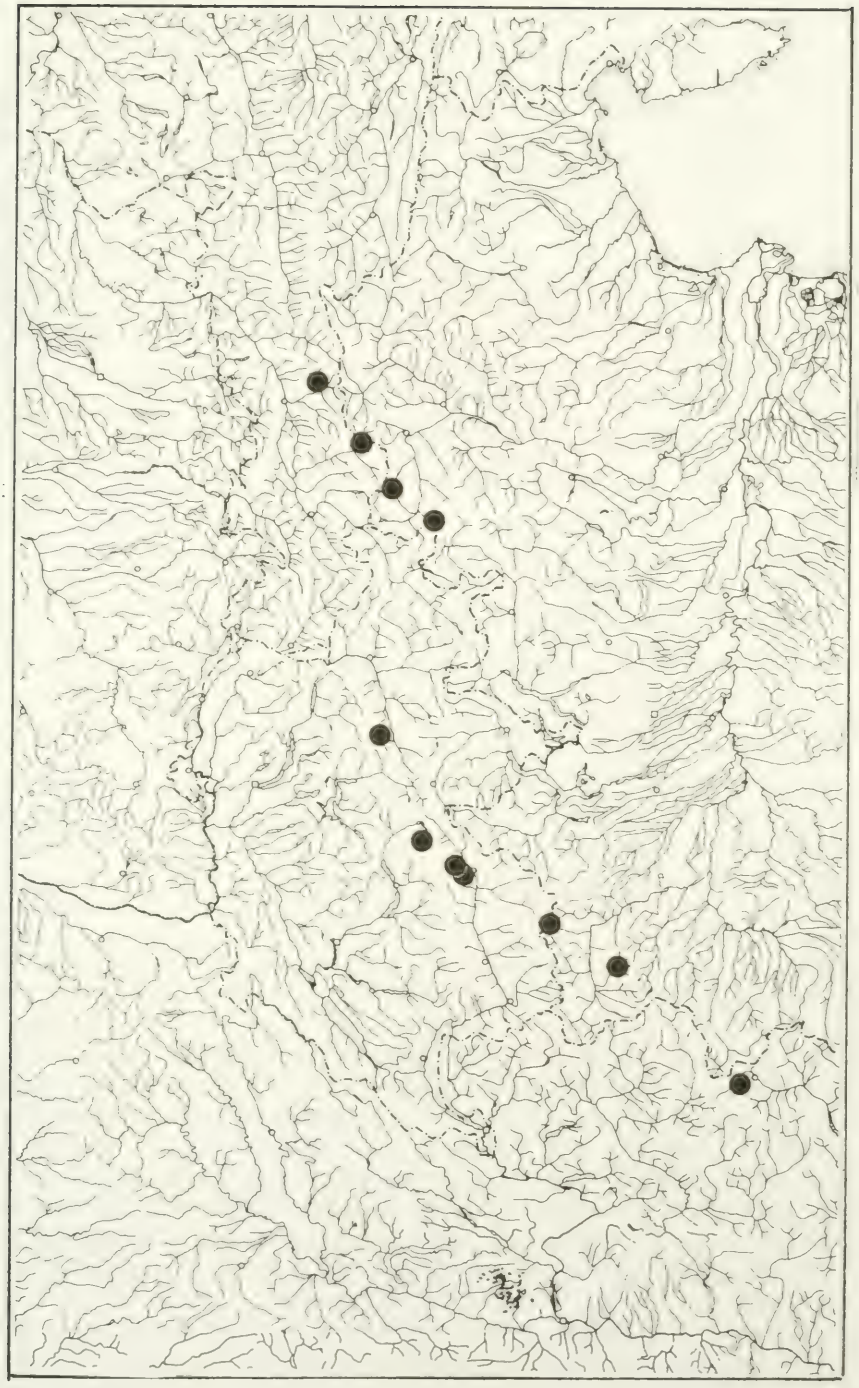

Figure 4: *Lecidea cerviniicola*: Distribution in the Austrian, Italian, Swiss and French Alps. This bipolar species is rarely collected outside the European Alps.

BOLD, Bibl. Lichenol. 34: 202–205 (1989); ANDREEV & MYRZAKULOVA, Bot. Zhurn. 77(3): 116 (1992); HERTEL, Bibl. Lichenol. 58: 155–156 (1995); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 32 (1998).

New records:

Austria. Salzburg: Salzburger Alpen, Hochkönig-Gruppe, Troyboden [47°25'N, 13°08'E], auf der Mitterberger Alm westlich Bischofshofen, vorgeschichtliche Scheidehalden, 1550 m, 19.8.1968, *Teuffert 118b* (M). – Tirol: Ötztaler Alpen, Schneide des Festkogels östlich ober Obergurgl, [46°51'N, 11°03'E], ca. 3000 m, VIII.1879, *Arnold* (M) – Gneisblöcke am Mittagskögele [46°56'N, 10°52'E], bei Mittelberg im Piztal, VIII.1875, *Arnold* (M, as *Lecidea promiscua* Nyl.) – Gneishänge bei Pillberg [46°54'N, 11°03' E], unterhalb Obergurgl, VIII.1955, *Poelt* (M) – Tuxer Voralpen, Schröffelkogel, am Rücken gegen den Bentlstein [47°06'N, 11°32'E], 2200 m, VIII.1960, *Doppelbaur, Poelt & Steiner* (M) – Lechtaler Alpen, Kaiserjoch, nördlich oberhalb Pettneu (47°10'N, 10°20'E), auf Kalkhornstein, 2318 m, 29.8.1892, *Arnold* (M) – Osttirol, Venedigergruppe, Umbaltal oberhalb der Pebell-Alpe [47°01'N, 12°18'E], 1860 m, 29.8. 1988, *Schuhwerk 2230* (M).

Switzerland. Kanton Wallis: Südseite des Schwarzhorns unter der Mischabelhütte bei Saas Fee, 3100 m, 19.8.1971, *Schuhwerk 1871* (M) – Rothhorn [46°01'N, 7°49'E] au dessus de Zermatt, *De Candolle 451* (G–DC, as *Lecidea pilati*).

France. Dépt. Hautes Alpes: Col de Granon [44°57'N, 6°37'E], NNW Briançon, 2400 m, 11.7.1970, *Hertel 11891* (M).

Italy. Prov. Bozen (Südtirol): Ortler Gruppe, Vordere Schöntaufspitze [46°30'N, 10°37'E] SE von Innersulden, 2400 m, 27.7.1970, *Hertel 11524* (M) – Ötztaler Alpen, Hochschwems [46°46'N, 10°45'E] NW oberhalb Kurzras im Schnalstal, 2500 m, 29.7.1970, *Hertel 11573* (M) – Ostgrat der Muthspitze oberhalb der Zufallshütte im obersten Martelltal [46°29'N, 10°40'E], 2500 m, 31.7.1979, *Hertel 11695* (M). – Prov. Sondrio: Ad rupes micaceas in alpibus montibusque Bormiensibus (M; ANZI, Lich. Langob. Exs. 401, as *Lecidea confluens* f. *ecrustacea*). – Prov. Val d'Aosta: River valley, a few kms below Cogne, on streamside boulders, granites and schists, 24.7.1966, *Weber L-43571* (COLO).

Spain. Prov. Granada: Sierra Nevada, Gipfelbereich des Mulhacén [37°02'N, 3°18'W], an Glimmerschiefer-Platten, 3350–3470 m, 30.7.1969, *Hertel 11741* (M).

Lecidea cerviniicola is a species which is often confused with either *Lecidea auriculata* or *L. promiscens*. Former records from the Alps (Austria, France, Italy) are given by CULBERSON & HERTEL (1972) and from Spain by HERTEL (1975a, 1992). Outside of Europe it is known from alpine localities in the Australian Alps (RAMBOLD 1989).

Lecidea cinerata Zahlbr.

ZAHLBRUCKNER, Bull. Torrey Bot. Club.: 644 (1900); MAGNUSSON, Meddel. Göteb. Bot. Trädgård 10: 38–39 (1936).

New record:

U.S.A. California: San Gabriel Range, 1898, *Hasse* (COLO; HASSE, Lich. Southern Calif. 899).

This specimen of HASSE's exsiccata does not contain *Lecidea fuscatoatra* Nyl., as indicated on the label. Besides brown thalli of *Acarospora* and *Rhizocarpon*, there are numerous apothecia of a cryptothalline lichen: *Lecidea cinerata*, a species described from the same area ("San Gabriel Range above Hollywood"). *L. cinerata* is known only from southern California. MAGNUSSON's record from Colorado needs confirmation, for MAGNUSSON was not aware of the chemical characters (schizopeltic acid and gyrophoric acid, see CULBERSON & HERTEL 1972) which characterize this species.

Lecidea confluens (Weber) Ach.

ACHARIUS, Method. Lich.: 14 (1803); SCHWAB, Mitt. Bot. Staatssamml. München 22: 314–322 (1986); HERTEL, Bibl. Lichenol. 48: 156 (1995); WIRTH, Flechten Baden-Württembergs 1: 513 (1995; macrophoto!); THOMSON, American Arctic Lichens 2: 338–339 (1997); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 33–35 (1998).

Confirmed synonym:

Lecidea lepadina Sommerf. – SOMMERFELT, Suppl. Fl. Lappon. 145 (1826); Th. FRIES, Lichenogr. Scand.: 485 (1874); LYNGE, Result. Norske Statsunderst. Spitsbergeneksped. 1(9): 24 (1926); MAGNUSSON, Ark. Bot. 2(2): 120 (1952). – Type: Norvegia, Nordland, in Hekkeltind Skjärstad, VIII.1822, *C. Sommerfelt* (O, lectotype, selected here). The specimen contains confluentic acid (major), 2'-O-methylmicrophyllinic acid, and 2'-O-methylperlatolic acid (both minor). – Already Th. FRIES (loc. cit.) regarded *Lecidea lepadina* as a growing form of *L. confluens*. As stated before (HERTEL 1995) we follow his estimation.

New records:

Svalbard. Spitsbergen: Kongsfjord, Blomstrandhalvøya, Irgensfjellet [78°59'N, 12°09'E], an kleinen, feucht liegenden Steinen am inneren Rand von Steinringen auf Polygonböden, ca. 150 m, 21.7.1975, *Hertel 16322 & Ullrich* (M). – Further Svalbard records are from Sørkapp Land and Bjørnøya (ELVEBAKK & HERTEL 1996).

Romania. Hunedoara: Circa lacum "Zenoga" infra alpem Retyezát [ca. 45°20'N, 22°50'E] in Transsylvania, ca. 6000', 9.8.1873, *Lojka 2467* (M, as *Lecidea lapicida*).

Greece. Bezirk Grevená [Γρεβενὰ]: Aufstieg zum Smólikas [Σμὸλικας] (von Samarína [Σαμαρινα] aus) [40°05'N, 20°57'E], NE-Hang, 2150 m, 15.7.1982, *Triebel 1836* (M).

Lecidea confluens is an often misunderstood species; and most of the literature records need reconfirmation.

Lecidea diducens Nyl.

NYLANDER, Flora 48: 148 (1865); CULBERSON & HERTEL, Bryologist 75: 372–375 (1972); HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 243–244 (1977); HERTEL, Mitt. Bot. Staatssamml. München 13: 340, 343–344 (1977 with distribution map), 28: 220 (1989), 30: 307–308 (1991); INOUE, J. Sci. Hiroshima Univ., ser. B, div. 2 (Botany) 18: 30–31 (1982); RAMBOLD, Bibl. Lichenol. 34: 208–210 (1989); INOUE, J. Hattori Bot. Lab. 76: 193–194 (1994); HERTEL, Bibl. Lichenol. 58: 158 (1995); HERTEL, Symb. Bot. Upsal. 32(1): 100 (1997); THOMSON, American Arctic Lichens 2: 340, 343 (1997); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 40–41 (1998).

New records:

Switzerland. Kanton Uri: Straße zum Gotthard-Paß südlich oberhalb Hospental [46°35'N, 8°33'E], 1500–1600 m, 10.8.1912, *Lettau* (B). The record was published by LETTAU (1954) as *L. promiscens* Nyl.

Italy. Prov. Bozen (Südtirol): Ortler-Gruppe, Vordere Schöntaufspitze [46°30'N, 10°37'E] südöstlich Innersulden, 2400 m, 27.7.1970, *Hertel 11501* (M) – Ötztaler Alpen, Hochschwems [46°46'N, 10°45'E], NW oberhalb des Gasthofs Kurzras im obersten Schnalstal, 2500 m, 29.7.1970, *Hertel 11573* (M).

Lecidea diducens is a widespread, bipolar taxon, often confused with *Lecidea auriculata* Th. Fr. It shares the C+ red excipulum and small oblong ascospores with *Lecidea cerviniicola*, but it has smaller ascospores and a different chemistry: 2'-O-methylanziaic acid and confluentic acid (instead of anziaic and perlatolic acid in *L. cerviniicola*).

Lecidea fuscoatra (L.) Ach.

ACHARIUS, Method. Lich.: 44 (1803); HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 244–248 (1977); BUSCHARDT, Bibl. Lichenol. 10: 186–190 (1979); HERTEL & ZHAO, Lichenologist 14: 147 (1982); ANDREEV & KUDRATOV, Bot. Zhurn. 77: 105 (1992); WONG & BRODO, Syllogeus 69: 50 (1992); HERTEL, Bibl. Lichenol. 58: 158 (1995); THOMSON, American Arctic Lichens 2: 346–347 (1997); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 47–49 (1998).

New records:

Germany. Bayern: Bayerischer Wald, Lkr. Cham, Brenntenstein am Kaitersberg (MTB 6843/2), südexponierte Steilflächen, 960 m, 24.6.1979, *Schuhwerk 1795* (M) – Oberbayern: Auf Dachziegeln eines Hauses bei Baierbrunn bei München, X.1888, *Boll* (M, ARNOLD, Lich. Exs. 1442) – Schwaben, Allgäuer

Alpen, Söllereck bei Oberstdorf, auf Glimmerschiefer, 1000 m, *Britzelmayr* (M; BRITZELMAYR, Lich. Exs. 795).

Italy. Prov. Napoli: Südhang des Vesuv [40°48'N, 14°25'E], sonnige Lavablöcke, 350 m, 2.5.1951, *M. Steiner* (M).

Romania. [Hunedoara:] Supra saxa micaceo-schistosa vallis "Riu mare" infra alpem Retyezát in Transsylvania, 1.8.1880, *Lojka* (M; LOJKA, Lich. Regni Hung. Exs. 141).

Greece, Makedonia: N.E. Chalkidiki, coastal rocks above the sea near Vouvora [Βουρβουρού, 40°11' N, 23°47'E], Sithonian Peninsula [Σιθωνια], 24.7.1971, *W.A. Weber & P.W. Richards L-54582* (COLO).

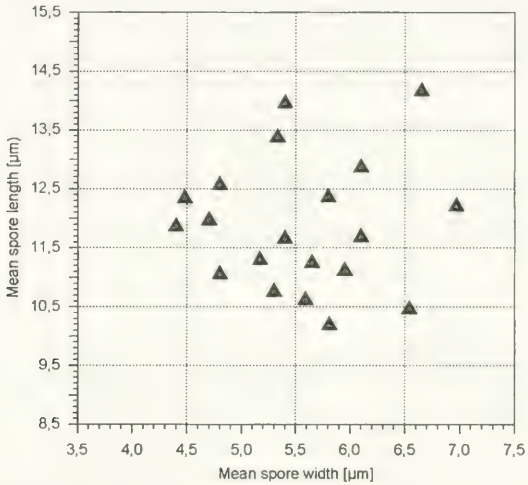

Figure 5: Spore size in *Lecidea fuscoatra* s.str. The diagram shows arithmetic means of measurments of spores. Dots based on series of 20–50 measurments.

Canada. British Columbia: Saltspring Island, 1 mile S of Southey Point [48°57'N, 123°36'W], near home of H. Sylvander, on coast near sea level, 27.4.1971, *C.D. Bird & R.D. Bird 25711* (CANL).

U.S.A. Michigan: Keweenaw Co., Isle Royale, on a rock on the dry south slope of Mt. Franklin, 48° 08'N, 88°33'W, 25.8.1972, *Thomson 17341* (MIN). – Oregon: Deschutes Co., Juniper Wayside, 7 miles E of Sisters, basalt rim-rock, north facing, 900 m, 15.2.1977, *Weber L-64583* (COLO) – Wasco Co., 48 km north of Madras between Shaniko and Antelope along Ward Creek, 44°58'N, 120°48'W, 1150 m, 18.8.1977, *Rossman 283* (COLO). – California: Santa Clara Co., Santa Cruz Mts., Hills near Stanford University [37°25'N, 122°10'W], 60 m, 23.4.1904, *Herre 410* (MIN) – Siskiyou Co., near the Ash Creek Bridge, off Hwy 96, along south shore of Klamath River, north of Yreka, 41°50'N, 122°38'W, 600 m, 26. 8.1989, *Ryan 25658* (ASU). – Wyoming: Teton Co., Yellowstone National Park, below Mystic Falls near Biscuit Basin, on north facing slope above stream in lightly burned area with Engelmann spruce, subalpine fir, 44°29'N, 110°53'W, 2410 m, 9.8.1998, *Wetmore 81978* (MIN).

Argentina. Prov. Río Negro: Lago Nahuel Huapí, Isla Victoria, en una roca en el pasto cerca de la orilla del lago, 28.I.1950, *Lamb 5852* (M). – New to South America.

Lecidea fuscoatra s.str. as circumscribed here is characterized by gyrophoric acid (often along with O-methylgyrophoric acid) as the major lichen substance, and a dark brown to blackish brown hypothecium (seen in sections ca. 15 µm thick).

Lecidea fuscoatrula Nyl.

NYLANDER, Lich. Nov. Zeland.: 106 (1888); RAMBOLD, Bibl. Lichenol. 34: 173–176 (1989); HERTEL, Mitt. Bot. Staatssamml. München 28: 221 (1989); HERTEL, Symb. Bot. Upsal. 32

(1): 100 (1997); MALCOLM & GALLOWAY, New Zealand Lichens: 21 (1997; black-and-white macrophoto, and colour macrophotos!).

New records:

South Africa. Western Cape Prov.: Jonkershoek [33°56'S, 22°13'E], 24.10.1963, *Almborn 83206* (LD; contains 2'-O-methylmicrophyllinic acid).

New Zealand. Canterbury: Eastern Bot. Distr., Lake Pukaki Hotel, on non-calcareous boulders in *Festuca novae-zealandiae* tussock at the road side, 12.3.1927, *E. Du Rietz & G. Du Rietz 2094 b* (UPS; contains 2'-O-methylmicrophyllinic acid (major) and norstictic acid).

Lecidea fuscoatrula is a Southern Hemisphere taxon (Southern xeric element), known from Australia (RAMBOLD 1989), New Zealand (HERTEL 1989) and South Africa (RAMBOLD 1989; no localities given).

Lecidea haerjedalica H.Magn.

MAGNUSSON, Bot. Notiser 1948: 403–404 (1948); HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 250–251 (1977); HERTEL, Mitt. Bot. Staatssamml. München 12: 130–132 (1975), 17: 173 (1981); HERTEL, Herzogia 5: 451 (1981); HERTEL, Bibl. Lichenol. 58: 160 (1995); HERTEL, Symb. Bot. Upsal. 32(1): 100 (1997) with distribution map; THOMSON, American Arctic Lichens 2: 347, 349 (1997); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 51 (1998).

New record:

Austria. Salzburg: Lungau, Schladminger Tauern, Lanschitzbachtal, NE der Lasshoferhütte, westlich unter der oberen Bacheralm, S-exponierte Blockschutthalde (MTB 8748/2), an schwermetallhaltigem Silikatgestein, 1560 m. 6.7.1995, *Möslinger (L-561) & Hafellner* (GZU).

Lecidea lapicida (Ach.) Ach. var. ***lapicida*** Ach.

ACHARIUS, Method. Lich. 37 (1803); HERTEL, Willdenowia 6: 241 (1971); HERTEL, Mitt. Bot. Staatssamml. München 17: 174 (1981), 21: 323–325 (1985), 23: 326–327 (1987), 28: 221–223 (1989), 30: 308–309 (1991); INOUE, J. Sci. Hiroshima Univ., ser. B, div. 2 (Botany) 18: 38–39 (1982); HERTEL & ZHAO, Lichenologist 14: 148 (1982); HERTEL, Beih. Nova Hedwigia 79: 419–420 (1984); HERTEL, Symb. Bot. Upsal. 32(1): 100 (1997); THOMSON, American Arctic Lichens 2: 356–357 (1997); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 57–59 (1998).

New records:

Austria. Steiermark: Schladminger Tauern, Kleinsölktal, Steinigboden über dem Schwarzensee (MTB 8749/1), an schwermetallhaltigem Gneis, 1400 m, 8.9.1993, *Möslinger L-662, Hafellner & Wilfling* (GZU).

Switzerland. Kanton Bern: Schwarzhorn [46°41'N, 8.04'E] über der Großen Scheidegg, nahe unter dem Gipfel, 2900 m, 20.7.1928, *Frey 324* (M) – Gipfel des Finsteraarhorns [46°32'N, 8°06'E], 4275 m, 10.8.1920, *Frey s.n.* (G; infected by *Muellerella pygmaea*, associated with *Sporastatia testudinea*). – Kanton Wallis: Aux Alpes du Mt. Rose sur Zermatt, 1854, *DeCandolle* (G-DC, as *Lecidea pilati*) – Val d'Hérens, Grande Dent de Veisivi [46°03'N, 7°32'E], Gneisgipfel, 3425 m, 4.8.1929, *Frey 448* (G, M).

Cyprus. Troodos-Gebirge, Chionistra (Mt. Olympos), 34°56'N, 32°58'E, 1850 m, Blöcke in schütterem *Pinus nigra* ssp. *pallasiana-Juniperus foetidissima*-Wald, 4.10.1994, *Hertel 38463* (M). – According to LITTERSKI & MAYRHOFER (1998) *Lecidea lapicida* var. *lapicida* was not yet recorded from the island of Cyprus.

Canada. Newfoundland: In spruce scrub barren above St. Anthony [51°22'N, 55°35'W], ca. 75 m, 22. 6.1953, *Lamb 7379* (M).

New Zealand. Central Otago: Old Man Range, SW of Alexandra, summit plateau near Hyde Rock, 45°21'S, 169°12'E, schist stones on ground in alpine tundra, 1610–1670 m, 3.2.1985, *Hertel 30386, Child & Mayrhofer* (M). – Already recorded from Otago (HERTEL 1985).

Lecidea lapicida s.str. is a very widespread and locally common taxon; HERTEL (1985) maps its world distribution and HERTEL (1997) its extra-holarctic distribution.

Lecidea lapicida (Ach.) Ach. var. ***maungahukae*** Hertel var. nov.

Holotype: New Zealand. South Island, Westland: Mt. Haast, Col between West Peak and Middle Peak, 2955 m, 10 January 1967, *Cunninghame* (CANU, herb. Fineran 2487; published as *Lecidea durietzii* H.Magn. by FINERAN & DODGE 1973).

Ethymology: *maunga huka* (Maori) = snowy mountain (REED 1982).

Diagnosis: Differt a *Lecidea lapicida* var. *pantherina* apotheciis minoribus (0.2–*0.4*–0.65 mm in diam.), areolis thalli minoribus, dispersis, stramineis et hypothecio brunneo.

Description: Thallus: Small, 3–12 mm in diam. Areolae roundish, 0.2–0.8 mm in diam., up to 0.15 mm tall, straw-coloured to beige, subbullate, with a shiny, smooth surface (due to an epinecrotic cortex layer ca. 20 μm thick), dispersed on a conspicuous, black, thin prothallus. Medulla I+ intense violet, K+ red (norstictic acid). – Apothecia: 80–120 per mm^2, mean diameter ca. 0.4 mm, maximum diameter 0.6(–0.8) mm, well constricted at base, with a well-developed black, shiny margin (ca. 70 μm wide) and a dull black, epruinose, flat to slightly convex disc. Internal structure as in *Lecidea lapicida*. – Hymenium: 55–*60*–63 μm tall, unpigmented, except an 9–13 μm wide, greenish upper part (epihymenium). – Subhymenium: 27–*34*–40 μm tall, unpigmented. – Hypothecium: 40–70 μm tall, dark brown (seen in sections 16 μm wide). – Ascospores: broadly ellipsoid, 7.0–*8.4*–*8.8*–10.5 × 4.0–*4.5*–*5.2*–6.3 μm, length-width-index: 1.6–1.8. – Pycnidia: immersed in thallus, ± globular, with bacilliform, apically formed conidia, 7–10 × ± 1.0 μm.

Anatomically this new variety is closely related to *Lecidea lapicida* var. *pantherina*. In terms of its gross morphology it is quite distinctive. Since *Lecidea lapicida* is a rather variable species, we are not yet absolutely sure whether this variety is a merely a morphodeme of high-altitude sites. On the other hand, we have studied many collections of *L. lapicida* from extreme altitudes and latitudes, but never before encountered such a morphology, which is identical in all three collections studied.

Additional specimens:

New Zealand. Westland: type locality, *Cunninghame (herb. Fineran 2488 & 2495)* (CANU; both labeled "*L. durietzii*") – Mt. Haidinger, Main Divide Ridge, 2925 m, on broken rock outcrop on western side of ridge, 7.I.1967, *Fineran 2519* (CANU; published by FINERAN & DODGE 1973 as *Lecidea pallidoatra* Nyl.) and *Fineran 2520* (CANU; published by FINERAN & DODGE 1973 as *Lecidea triangularis* H.Magn.).

Lecidea lapicida (Ach.) Ach. var. ***pantherina*** Ach.

ACHARIUS, Kongl. Svenska Vetenskapsakad. Handl.: 232 (1808); HERTEL, Mitt. Bot. Staatssamml. München 28: 223 (1989), 30: 309 (1991); HERTEL, Bibl. Lichenol. 58: 162 (1995); WIRTH, Flechten Baden-Württembergs 1: 515 (1995; macrophoto!); HERTEL, Symb. Bot. Upsal. 32(1): 101, 103 (1997); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 59 (1998); THOMSON, American Arctic Lichens 2: 352, 355-356 (1997).

New synonym:

Lecidea deagostinii Sambo, I licheni della Terra del Fuoco: 25 (1926). – Typus: [Argentina] Tierra del Fuego, sue sassi a Río del Fuego, 1910, *Tonelli* (FI, holotype; a very small specimen; thallus areolated, grey, K+ red, I+ intensely violet, Hymenium 60–70 μm, epihymenium olive green, subhymenium 15–30 μm, hypothecium dark brown, spores 11–13 × 5.5–6.5 μm).

New records:

Russia. Respublika Kabardino-Balkaria: Caucasus Centralis, distr. Tyrnyauz, regio montis Elbrus, vicinitatis lacus Donguzorumkoel, in declivibus occid. montis Cheget, 2400–2600 m, 20.6.1980, *Vašák* s.n. (M).

Canada. Northwest Territories: [Mackenzie district:] Central Mackenzie Mts., Keele River Region, Tigonankweine Region, 63°40'N, 127°52'W, 1680 m, 8.8.1971, *Scotter 16176* (WIS). – Nunavut: Hood River, Wilberforce Falls area, 1 mile upstream of fall along the west bank of the Hood River, south facing, 10° inclined slope, 67°04'N, 108°46'W, 140 m, 16.8.1990, *Gould 1769* (MIN). – Alberta: Jasper National Park: Ridge opposite Angel Glacier on Mt. Edith Cavell [52°40'N, 118°03'W], 1980 m, 16.7. 1950, *Imshaug 6993* (MSC, beside *Carbonea vorticosa* and *Tremolecia atrata* (Ach.) Hertel). – Newfoundland: Avalon Peninsula, on bedrock along shore, Williams Cove, Bay Bulls, 47°18'N, 52°47'W, 21. 11.1978, *D.P. Weber* (MICH).

New Zealand. Canterbury: Summit of Mt. Peel, 43°51'S, 171°09'E, 1750 m, 16.1.1985, *Hertel 29574, Mayrhofer, Meurk & Molloy* (M). – Otago: Hyde Rock, Old Man Range, 45°19'–23'S, 169°12'E, 1610–1670 m, 3.2.1985, *Hertel 30359, Child & Mayrhofer* (M) – Mt. Maungatua, 45°54'S, 170°08'E, SW of Dunedin, 850–890 m, 31.1.1985, *Hertel 30050, Mark & Mayrhofer* (M).

Lecidea lapicida var. *pantherina* is a bipolar taxon. In arctic and subarctic regions of the Northern Hemisphere it seems to be common. ANDREEV (1998) mentions it from "Northern Kavkas". Its extra-holarctic distribution (including localities in Tierra del Fuego) is mapped by HERTEL (1997).

Lecidea leprosolimbata (Arnold) Lettau ex Poelt

POELT, Mitt. Bot. Staatssamml. München 3: 578 (1960); CLAUZADE & ROUX, Bull. Soc. Linn. Provence 27: 42–43 (1974); HERTEL, Bibl. Lichenol. 58: 162–163 (1995); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 60–61 (1998) ≡ *Lecidea atrobrunnea* var. *leprosolimbata* Arnold, Verh. Zool.-Bot. Ges. Wien 39: 264 (1889); HERTEL, Beih. Nova Hedwigia 24: 115–117 (1967); HERTEL, Herzogia 1: 33 (1968); KILIAS, Hoppea, Denkschr. Regensb. Bot. Ges. 37: 119 (1978).

New record:

Austria. Tirol: [Tuxer Voralpen] Ostgrat des Mieslkopfes [47°09'N, 11°32'E] bei Navis östlich Matrei am Brenner, 2450 m, 10.9.1971, *Schuhwerk 754* (M).

Lecidea leprosolimbata is an alpine, calciphilous species, normally starting its life-cycle as a lichenicolous species on the thallus of *Bellemerea subcandida* (Arnold) Hafellner & Cl. Roux (soon becoming independent, but very often found next to this host). Morphologically it is closely related to *Lecidea syncarpa* Zahlbr., a rather widespread taxon of the *Lecidea atrobrunnea* complex exclusively colonizing acid rocks. Both lichens have norstictic acid as the major lichen substance. *L. leprosolimbata* is known from the Alps, Pyrenees, and the Cordillera Cantabrica (HERTEL 1995). For plant-geographical and ecological reasons, we doubt the record of Morocco (WERNER 1974 – "Volcan de l'Ari Hebbri, sur basalte dans le Cedretum, 2000–2100 m") as well as that of Corsica (WERNER & DESCHARTES 1974 – "Mte. Cinto, 1400 m, sur rochers dioritiques").

Lecidea leucothallina Arnold var. ***leucothallina***

ARNOLD, Verhandl. Zool.-Bot. Ges. Wien 29: 382 (1879); HERTEL, Mitt. Bot. Staatssamml. München 12: 133–134 (1975); ANDREEV & ANTONOVA, Novit. Syst. Plant. non Vascul. 26: 97 (1989); HERTEL, Bibl. Lichenol. 58: 163 (1995); THOMSON, American Arctic Lichens 2: 358, 360 (1997).

New records:

Austria. Tirol: Ötztaler Alps, Itlsee [46°53'N, 11°01'E] über Obergurgl, 2675 m, an niedrigem Block im Polytrichetum sexangularis, 14.7.1982, *Schuhwerk 827/10* (M).

From the Alps this lichen acid deficient variety was mainly reported by ARNOLD (1879, 1886, 1887, 1889). In M the following collections are preserved:

Austria. Tirol: Kühkampleseck [46°51'–52'N, 11°02'–03'E, ridge W of Mt. Festkogel, 2500 m] östlich ober Gurgl, an Glimmerblöcken, VIII.1878, Arnold (M) – Im kahlen Gehänge östlich ober Gurgl, ca. 2400 m, an Glimmerblöcken, 7.8.1879, *Arnold* (M; ARNOLD, Lich. Exs. 760 b) – Oberhalb des Schwar-

zensteinsees [47°02'N, 11°50'E, ca. 2600–2700 m] im obersten Zillertal, an Glimmerschieferblöcken, VIII.1887, *Arnold* (M) – Am Wege zu den Finstertaler Seen [47°12'N, 11°01'E, ca. 2100 m] bei Kühthei, an Gneisblöcken, VII.1884, *Arnold* (M).

Italy. Prov. Trento: Kahle Felswüste rechts ober dem Col Briccon (46°17'N, 11°45'E, ca. 2700 m] bei Paneveggio, an Porphyrfelsen, 29.8.1883, *Arnold* (M; ARNOLD, Lich. Exs. 760c) – Val Maor, Übergang nach Caoria [Forcella di Valmaggiore, 46°16'N, 11°40'E, 2180 m], an Porphyr, VII.1880, *Arnold* (M) – Gipfel der Vocche [Cima di Bocche, 46°21'N, 11°45'E, 2745 m] nördlich ober Paneveggio, VIII.1884, *Arnold* (M; two specimens).

Lecidea leucothallina Arnold var. ***kujalae*** (Räsänen) Hertel

HERTEL, Bibl. Lichenol. 58: 164 (1995); ANDREEV in ANDREEV, KOTLOV & MAKAROVA, Opredel. Lishayn. Rossii 7: 62 (1998) ≡ *Lecidea kujalae* Räsänen, Ann. Bot. Soc. Zool.-Bot. Fenn. Vanamo 18(1): 76 (1943).

New records:

Iceland. Eyjafjarðarsýsla: Klaengsholl-Kargletscher im Skiðalur, W Eyjafjord, ca. 25 km NW Akureyri, 65°47'N, 19°35'W, 700–800 m, 1983, *H.-H. Meyer* (M).

U.S.A. Colorado: Routt Co., W slope of Hahn's Peak [40°51'N, 106°56'W], 2745 m, 3 miles E of Columbine, on shaded talus blocks, 22.6.1965, *Weber* (WEBER, Lich. Exs. Colo. 155; GZU, W – as *Lecidea atrobrunnea*). – Montana: Deer Lodge Co., Storm Lake [46°04'N, 113°16'W], Deer Lodge National Forest, Continental Divide south of Georgetown and Anaconda, 2380 m, on granite boulders at base of talus in open *Picea-Abies*-forest, 1./2.8.1976, *Weber & Lackschewitz* (M; WEBER, Lich. Exs. Colo. 525, as *Lecidea atrobrunnea*).

In North America, *Lecidea leucothallina* (s.l.) is known from alpine localities in Alberta, Colorado, Montana, and Washington (ANDERSON 1965; see also map in HERTEL 1975b). All these records may belong to var. *kujalae*, for ANDERON (loc.cit.) notes: "thallus ... ... P+ weak yellow-orange". This colour reaction is due to pannarin which is deposited in a thin layer (30–50 μm thick) within the thallus cortex. Microscopically, this pannarin-containing layer is of an opaque, milky brownish colour and gives (microscopically controlled) an intense P+ orange reaction. – New to America.

Lecidea leucothallina Arnold var. ***subdiscrepans*** Rambold & Hertel in Hertel

HERTEL, Bibl. Lichenol. 58: 163 (1995).

New record:

Austria. Tirol: Ötztaler Alpen, Gipfel der Kreuzspitze [46°49'N, 10°52'E] bei Vent, 3455 m, 22.8. 1877, *Arnold* (M).

Known from Norway and Austria (HERTEL 1995).

Lecidea lygomma Nyl. in Cromb.

CROMBIE, J. Bot. (London) 13: 334 (1875); HERTEL, Mitt. Bot. Staatssamml. München 23: 327–329 (1987), 28: 223–224 (1989); RAMBOLD, Bibl. Lichenol. 34: 214–219 (1989); HERTEL, Symb. Bot. Upsal. 32(1): 103–104 (1997) ≡ *Zosterodiscus lygomma* (Nyl.) Hertel, Beih. Nova Hedwigia 79: 425–426 (1984).

New records:

Uganda. District Toro: Ruwenzori. Zentrale Gipfelgruppe, 4480 m, an Felsbrocken zwischen *Poa* und *Helichrysum*, VI.1984, *Schmitt* (M). – New to Africa.

New Zealand. Gisborne: East Cape, Mt. Hikurangi [37°55'S, 178°03'E], ca. 1200 m, 19.12.1982, *Bartlett* (M). – Nelson: Tasman Mts., Lonely Lake, ca. 1270 m, 20.12.1983, *Bartlett 26998* (M) – Owen Range, schist soil area, ca. 1130 m, 16.12.1982, *Bartlett 27031* (M) – Upper Cobb Valley, headwaters of Burgoo Stream, ca. 1180 m, 16.12.1983, *Bartlett 26969a* (M). – Canterbury: Arthur's Pass National Park, Temple Basin, 42°54'S, 171°35'E, 1500 m, 23.I.1985, *Hertel 29843* (M). – Otago: Old Man Range, SW of Alexandra, summit plateau, between Hyde Rock and Obelisk, 45°19'–23'S, 169°12'E, 1665 m, on loose schist plates in alpine situation, near to the stand of *Cetraria delisei*, 3.2.1985, *Hertel 30324, Child*

& Mayrhofer (M) – Mt. Maungatua, SW of Dunedin, 45°54'S, 170°08'E, rocks at swampy summit plateau, 890 m, 31.1.1985, *Hertel 30069, 30074, 30075, Mark & Mayrhofer* (M) – Arrowtown [44°56'S, 168°49'E], ca. 1000 m, 15.9.1976, *Bartlett 27036, 27046* (M). – Auckland Islands: Auckland Island, summit ridge SE of Mt. Easton, NW of Lake Hinemoa, 550 m, 17.12.1972, *Imshaug 56494* (MSC). – In New Zealand, *Lecidea lygomma* var. *lygomma* is the most common species of the genus *Lecidea*. In that respect, it plays a similar part there as *Lecidea lapicida* does in the Alps.

Lecidea lygomma Nyl. in Cromb. var. ***crassilabra*** (Müll.Arg.) Hertel & Rambold

HERTEL & RAMBOLD in HERTEL, Symb. Bot. Upsal. 32(1): 104 (1997) ≡ *Lecidea crassilabra* Müll.Arg., Hedwigia 32: 127 (1893); RAMBOLD, Bibl. Lichenol. 34: 205–207 (1989).

New records:

New Zealand. Nelson: Cobb Valley, schist saddle leading to Mt. Aorere [41°01'S, 172°29'E], 1850 m, 8.12.1981, *Bartlett 22832b* (M). – Otago: Rock and Pillar Range, summit rocks [45°23'S, 170° 08'E], 1430–1445 m, 28.I.1985, *Hertel 32266, Mayrhofer & Mark* (M) – Obelisk Range, Old Man Range SW of Alexandra, 45°19'–23'S, 169°12'E, 1610–1640 m, 3.2.1985, *Hertel 30341, Child & Mayrhofer* (M). – The Remarkables, around Lake Alta, 45°04'S, 168°48'E, 1805 m, 5.2.1985, *Hertel 30451, 30453, 30454 & Mayrhofer* (M) – Double Cone above Lake Alta, 45°04'S, 168°48'E, 2250–2280 m, 5.2.1985, *Hertel 30421 & Mayrhofer* (M) – Mt. Maungatua, SW of Dunedin, 45°54'S, 170°08'E, rocks at swampy summit plateau, 850–890 m, 31.I.1985, *Hertel 30073, 30088, Mark & Mayrhofer* (M).

Lecidea lygomma var. *crassilabra* is also known from Australia (RAMBOLD 1989) and Patagonia (HERTEL 1997). Formerly there was only a single record for New Zealand (HERTEL 1992) from Central Otago (Old Man Range).

Lecidea plana (J. Lahm in Körb.) Nyl.

NYLANDER, Flora 55: 552 (1872); HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 268–269 (1977); CULBERSON & HERTEL, Bryologist 82: 189–197 (1979); INOUE, J. Sci. Hiroshima Univ., ser. B, div. 2 (Botany) 18: 41–43 (1982); RAMBOLD, Bibl. Lichenol. 34: 222–224 (1989); HERTEL Bibl. Lichenol. 58: 166 (1995); WIRTH, Flechten Baden-Württembergs 1: 507 (1995; macrophoto!); THOMSON, American Arctic Lichens 2: 371–373 (1997); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 71–72 (1998).

New records:

Germany. Baden-Württemberg: Südschwarzwald, Gfällfelsen bei Oberried, 8.3.1977, *Schuhwerk 1287* (M). – Bayern: Niederbayern, Bayerischer Wald, Plöckenstein-Gebiet, bei Riedelsbach (MTB 7248 /2), 4.8.1985, *Schuhwerk 1787-1* (M).

Slovakia. Carpati: Tatra Magna, montes Belanské Tatry, in convalle Predné Med'odoly, 1700 m, 18. 8.1958, *Vězda* (M; VĚZDA, Lich. Bohemoslov. Exs. 255, as *Lecidea promiscua*).

New Zealand. Central Otago: Old Man Range, SW of Alexandra, summit plateau, between Hyde Rock and Obelisk, 45°19'–23'S, 169°12'E, 1665 m, on loose schist plates in alpine situation, near to the stand of *Cetraria delisei*, 3.2.1985, *Hertel 30325, Child & Mayrhofer* (M). – *Lecidea plana* seems to be a rare lichen in New Zealand, with only two records previously published (HERTEL 1984).

"Lecidea" polycocca Sommerf.

SOMMERFELT, Suppl. Fl. Lappon. 147–148 (1826); HERTEL, Herzogia 2: 495 (1973); THOMSON, American Arctic Lichens 2: 373 (1997).

= *Lecidea dissipata* H.Magn. – MAGNUSSON, Ark. Bot. ser. 2, 2: 115 (1952); HERTEL, Beih. Nova Hedwigia 24: 75–76 (1967); HERTEL, Herzogia 2: 235–236 (1971).

New record:

Svalbard. Spitsbergen: Haakon VII Land, Grøhuken, 79°47'N, 14°30'W, summer 1977, *Sweet* (COLO *L-65995*).

"Lecidea" polycocca, a member of Lecanoraceae, is a tiny calcicolous, arctic-alpine lichen. It is known from Scandinavia (FRIES 1874, MAGNUSSON 1952, HERTEL 1968, 1970), from the

Alps (HERTEL 1971a), and arctic Canada (HERTEL 1981). MAKAROVA & al. (1988) report it from Kotelnyi Island (Novosibirsk Isl.). From Svalbard it was known from a single collection (Kongsfjord area – HERTEL 1991).

Lecidea promiscens Nyl.

NYLANDER, Flora 55: 358 (1872); HERTEL, Herzogia 2: 244–248 (1971); HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 272–274 (1977); RAMBOLD, Bibl. Lichenol. 34: 224–226 (1989); HERTEL, Mitt. Bot. Staatssamml. München 13: 346–348 (1977), 30: 312 (1991); HERTEL, Bibl. Lichenol. 58: 167 (1995); HERTEL, Symb. Bot. Upsal. 32(1): 106–107 (1997); THOMSON, American Arctic Lichens 2: 373, 375 (1997); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 77 (1998).

New records:

Austria. Tirol: Ötztaler Alpen, Nördliche Seitenmoräne des Rotmoosferners [46°50'N, 11°03'E] südlich Obergurgl, Glimmerschiefer-Block, 2600 m, 13.7.1982, *Schuhwerk* (M) – Tuxer Voralpen, Geierspitze südlich Wattens bei Innsbruck, 47°08'N, 11°38'E, 2850 m, 28.8.1968, *Hertel 8974* (M).

Switzerland. Kanton Wallis: Penninische Alpen, Gipfel der La Ruinette [45°59'N, 7°24'E] über dem Val de Chanrion, 3875 m, 7.8.1976, *Schuhwerk 1016* (M).

Greece. Évia [Euboea]: am Berg Ohi [Ochi], 38°03'N, 24°27'E, NW von Káristos, an windverfegtem Grat, 1200 m, 14.6.2000, *Stuhrmann* (M). – Pilion-Gebirge: NW der Straße von Portaria, 11 km nach Portaria, [39°24'N, 23°02'E], 1000–1200 m, 24.7.1972, *V. & G. Melzheimer* (M).

Spain. Prov. Granada: Sierra Nevada, Gipfel des Mulhacén [37°02'N, 3°18'W], 3350–3470 m, 30.7. 1969, *Hertel 11744* (M).

Lecidea rapax Hertel

HERTEL, Herzogia 1: 426–427 (1970); HERTEL, Bibl. Lichenol. 58: 169 (1995); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 80 (1998).

New records:

Austria. Tirol: Silvretta-Gruppe, im oberen Jamtal oberhalb Galtür, Gneisblock auf einer Almwiese etwas unterhalb der Betonbrücke über den Jambach unterhalb des Zollhauses [46°53'N, 10°11'E], ca. 2000 m, 15.8.1983, *Hertel 25273* (M).

Switzerland. Kanton Wallis: Penninische Alpen, bei Pierracarrot [45°59'N, 7°23'E] im Val de Chanrion, 2400 m, an niedrigen Blöcken, 8.8.1976, *Schuhwerk* (M).

Lecidea sarcogynoides Körb.

KÖRBER, Syst. Lich. Germ. 252 (1855); HERTEL, Decheniana 127: 56, 72 (1975); BUSCHARDT, Bibl. Lichenol. 10: 198–200 (1979); HERTEL, Mitt. Bot. Staatssamml. München 21: 422 (1984), 28: 224 (1989); RAMBOLD, Bibl. Lichenol. 34: 185–189 (1989); HERTEL, Bibl. Lichenol. 58: 169–170 (1995); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 81–82 (1998).

New records:

France. [?]: "La Passioniére", 16.2.1885, *F. Hy* (MSC).

Italy. Prov. Savona: Mte. Bignone über Alassio, IV.1960, *Poelt* (M) – Spotorno, Tosse, 21.12.1955, *Sbarbaro 18* (M), *Sbarbaro 19* (M). – Prov. Livorno: Isle d'Elba, Valle della Permonte, IV.1984, *Pietschmann 319* (M).

Algeria. [Aurès:] Constantine, *Flagey* (H-Nyl 15661). A typical specimen, correctly identified by NYLANDER.

Lecidea speirodes Nyl.

Nova Hedwigia 24: 41–43 (1967); HERTEL, Herzogia 2: 48 (1970).

New record:

France. Dépt. Hautes Alpes: Aiguille de Chambeyron [44°32'N, 6°51'E], NE oberhalb St. Paul, am Col de Vars, 3300 m, 11.9.1996, *Schauer* (M).

Lecidea speirodes is a rare, calciphilous lichen, known from the Alps, Pyrenees (HERTEL 1967, HOUMEAU & ROUX 1991, van den BOOM & al. 1995), Cordillera Cantabrica (KILIAS

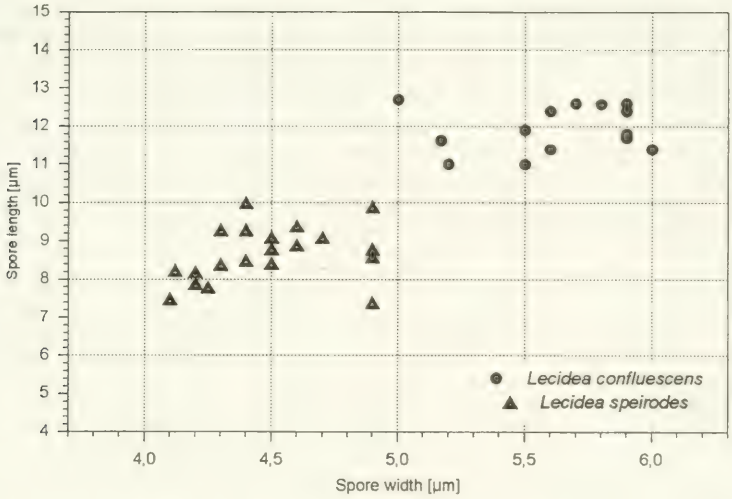

Figure 6: Spore size in *Lecidea speirodes* and *Lecidea confluescens*, two related taxa, which easily can be confused without using chemical characters (exciplulum C+ red in *L. speirodes*, C– in *L. confluescens)*. The diagram shows arithmetic means of measurments of spores. Dots based on series of 20–50 measurments.

1978), and the Tatra Mtns. (VĚZDA 1998), and is characterized e.g. by its C+ red exciple (2'-O-methylanziaic acid; see CULBERSON & HERTEL 1972). The somewhat similar *Lecidea confluescens* Nyl., often collected together with *L. speirodes*, differs in its C-negative exciple and larger spores (fig. 6).

Lecidea terrena Nyl. in Cromb.

CROMBIE, J. Linn. Soc. London, Bot. 15: 177 (1876); RAMBOLD, Bibl. Lichenol. 34: 189–196 (1989).

New synonym:

Lecidea subsquamifera Zahlbr., Annal. Crypt. Exot. 5: 231–232 (1932). – Type: Africa meridionalis, Gouritzrivier [= Gourits R., Little Karroo, ca. 33°20'–34°08'S, 21°45'E, South Africa, Western Cape Prov.], ad saxa arenaria, *van der Byl 828* (W, holotype).

Lecidea terrena is a rather variable species (RAMBOLD 1989). VAN DER BYL's collection shows ascospores [n = 40] of 13.0 × 7.5 µm size, short bacilliform conidia (6.0–*7.3*–8.5 × 0.7–1.0 µm) and confluentic acid (with traces of 2'-O-methylperlatolic, and 2'-O-methylmicrophyllinic acid) as lichen substances. ZAHLBRUCKNER placed his new species next to *Lecidea squamifera* Stizenb. [= *L. terrena* – see RAMBOLD loc.cit.] because of supposedly larger spores and smaller thallus areoles.

Lecidea umbonata (Hepp) Mudd

MUDD, Manual Brit. Lich. 204 (1861); HERTEL, Beih. Nova Hedwigia 24: 37–40 (1967); HERTEL, Herzogia 1: 51–52 (1970), 2: 249–251 (1971), 2: 497–499 (1973), 4: 379, 398 (1977);

HERTEL, Mitt. Bot. Staatssamml. München 12: 140 (1975), 28: 225 (1989), 30: 315 (1991); THOMSON, American Arctic Lichens 2: 386, 388–389 (1997); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 95–96 (1998).

New records:

France. Dépt. Hautes Alpes: Aiguille de Chambeyron [44°32'N, 6°51'E], NE oberhalb St. Paul, am Col de Vars, 3300 m, 11.9.1996, *Schauer* (M). – Dépt. Basses Alpes: Col de Bonette (le Restefond), ESE Barcelonette, 2820 m, 10.9.1996, *Schauer* (M). – Dépt. Hautes Pyrenées: Pic du Midi de Bigorre, *Ramond* (W, as *Lecidea turgida*). The collection was mentioned by SCHAERER (1850) as *Lecidea turgida* (= *Stenhammarella turgida* (Ach.) Hertel).

Italy. Prov. Bozen (Südtirol): Gipfelbereich des Sass Sóngher [46°34'N, 11°52'E] nördlich Colfuschg, 2650 m, 29.8.1981, *Feuerer 12159* (M). – Piemonte, Prov. Torino: Alta Valle di Susa, ca. 10 km NE of Bardonecchia, Vallone di Rochemolles, surroundings of the lake at the mountain refuge "Rifugio Scarfiotti", 45°08'N, 6°48'E, 2180 m, 20.8.1995, *Triebel & Rambold 6284* (M).

Lecidea variegatula Nyl.

NYLANDER, Flora 48: 6 (1865); HERTEL, Beih. Nova Hedwigia 24: 112–113 (1967); JOHN, Beitr. Landespflege Rheinland-Pfalz 13: 60 (1990; macrophoto!); HERTEL, Bibl. Lichenol. 58: 176 (1995); HERTEL, Symb. Bot. Upsal. 32(1): 109 (1997); ANDREEV in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 96–97 (1998).

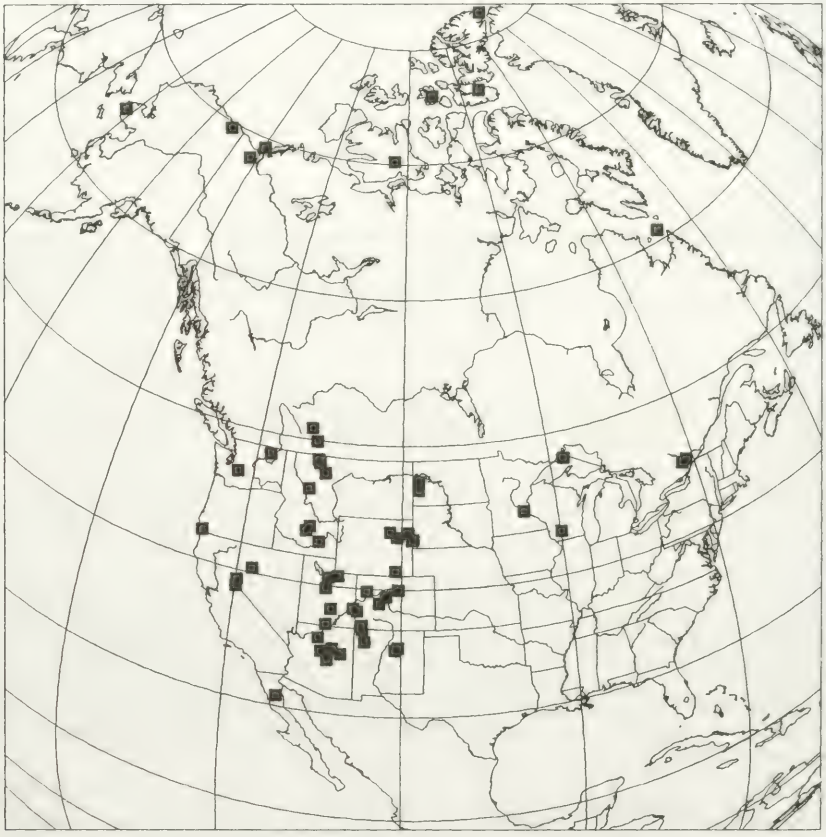

Figure 7: Distribution of *Lecidella pataviana* in North America. (Based on specimens seen and on data presented by KNOPH & LEUCKERT 1994).

New record:

Poland. [Bezirk Opole]: Oberschlesien, Basaltblöcke an Wegrändern bei Ujest [= Ujazd, 50°23'N, 18°20'E], VIII.1890, *Eitner* (M).

Lecidea variegatula is one of the smallest species of the genus and is probably often overlooked. The species is only known from low altitudes (plains to lower montane belts) and seems to be a pioneer on siliceous pebbles in humid climates. It is also reported from South America (HERTEL 1997, with distribution map). Other recent European records are from Austria (BERGER & PRIEMETZHOFER 2000), the Czech Republic (VĚZDA 1995), and from the Netherlands (BRAND & SPIER 1996).

Lecidella pataviana (A.Massal.) Knoph & Leuckert

KNOPH & LEUCKERT, Bibl. Lichenol. 36: 116–129 (1990); HERTEL, Mitt. Bot. Staatssamml. München 30: 315 (1991); ANDREEV & KUDRATOV, Bot. Zhurn. 77: 108–109 (1992); TÜRK & WUNDER, Nationalpark Berchtesgaden Forschungsber. 42: 61 (1999 – colour-macrophoto).

= *Lecidella inamoena* (Müll.Arg.) Hertel, Willdenowia 6: 249 (1971); THOMSON, American Arctic Lichens 2: 398–400 (1997).

New records:

Svalbard. Spitsbergen: Kongsfjord, Brøggerhalvøya. Vorland nördlich des Zeppelinfjellet (südlich Ny Ålesund) [78°55'N, 11°59'E], über Kalk, 12.7.1975, *Hertel 17582,17591* (M) – Vorland zwischen Lovenbreen I und Lovenbreen II [78°54'N, 12°06'E], SE Ny Ålesund, Dolomit-Rippen, 12.7.1975, *Hertel 17596* (M). – Well known from various areas in Spitsbergen (ELVEBAKK & HERTEL 1996).

Switzerland. Kanton Graubünden: Samnaun, Alp-Trida-Sattel [46°59'N, 10°21'E], oberhalb Compatsch, westlich oberhalb der Bergstation der Seilbahn, 2500 m, über Kalk, 27.7.2000, *Albertshofer* (M).

France. Dépt. Hautes Alpes: Aiguille de Chambeyron [44°32'N, 6°51'E], NE oberhalb St. Paul, am Col de Vars, 3300 m, 11.9.1996, *Schauer* (M). – Dépt. Basses Alpes: Col de Bonette (le Restefond) [44° 24'N, 6°53'E], ESE Barcelonette, 2820 m, 10.9.1996, *Schauer* (M).

Russia. Krasnoyarsk Territory: Center of Taimyr Peninsula, Byrranga Mtns, northern extremity of Levinson-Lessing Lake, by the Skalistyi stream valley, 74°33'N, 98°26'E, 180 m, 26.8.1995, *Zhurbenko 95120* (M, tiny accompanist of *Sporastatia testudinea*).

Algeria. [Aurès] Constantine: Sahara-Atlas, Dj. Tuggurt [= Djebel Tougar, 35°33'N, 6°01'E], Gipfel des Pic des Cèdres, 2000 m, 6.8.1954, *Doppelbaur 134* (M). – Already known from Algeria (KNOPH 1990).

Greenland. N. Greenland: Jørgen Brønlund Fjord, Pyramideplateauet, 82°12'N, 29°53'W, 27.6.1988, *Hansen* (M, Lich. Groenl. Exs. 3$3; tiny accompanist of *Sporastatia testudinea*).

U.S.A. Arizona: Coconino Co., upper end of Oak Creek Canyon, ca. 23 km SW of Flagstaff, 35°02'N, 111°51'W, 2000–2025 m, 11.6.1998, *Hertel 40334, 40336* (M) – Gila Co., East Verde River Canyon, upriver from where it intersects with the Houston Mesa Rd., ca. 14 km NNE of Payson, 34°21'N, 111°17' W, 1440–1510 m, 30.5.1998, *Hertel 39708* (M) – Gila Co., vicinity of Whispering Pines, along the Houston Mesa Road, 16 km NNE of Payson, 34°21'N, 111°17'W, 1540–1600 m, 30.5.1998, *Hertel 39736* (M). – California: Alpine Co./Eldorado Co., subalpine area on summit of Freel Peak, [38°51'N, 119°53'W], 3320 m, 25.7.1955, *Imshaug 18275b* (MSC). – Colorado: Gunnison Co., summit ridge of White Rock Mt., Elk Mts., 38°59'N, [106°58'W], 3900 m, 13.7.1952, *Imshaug 10979* (MSC) – Virginia Basin, Elk Mts., 38°59'N, [106°58'W], 3660 m, 5.7.1952, *Imshaug 10616* (MSC) – Gunnison Co., summit of Gothic Mt., Elk Mts., 38°57'N, 3855 m, 1.7.1952, *Imshaug 10396* (MSC). – Idaho: Custer Co., Leatherman Pass, Lost River Range, 44°05'N, 113°45'W, 3280 m, 29.7.1954, *Imshaug 16549* (MSC) – Custer Co./Blaine Co., Hyndman Pass, Pioneer Mts., 43°45'N, [114°03'W], 3200 m, 31.7.1954, *Imshaug 16636* (MSC). – Montana: Glacier Co., Glacier National Park, Siyeh Pass, 48°43'N, [113°38'W], 2500 m, 17.8.1950, *Imshaug 8950, 9014, 9027* (MSC) – Glacier National Park, summit of Goat Mt., [48°42'N, 113°35'W], 2680 m, 5.7.1950, *Imshaug 6548* (MSC) – Glacier National Park, Dawson Pass [48°29'N, 113°28'W], 2290–2440 m, 13.8.1950, *Imshaug 8617* (MSC). – Nevada: Washoe Co., summit of Mt. Rose, 39°20'N, [109°54'W], Carson Range, Sierra Nevada, 3284 m, 26.7.1955, *Imshaug 18259* (MSC). – Utah: Juab Co., summit of Mt. Nebo, Wasatch Mts., 39°49'N, [111°46'W], 3618 m, 14.8.1954, *Imshaug 16842* (MSC) – Salt Lake Co./Utah Co., Divide NE of Mt. Timpanogos, Wasatch Mts., 40°34'N, [111°

38'W], 3307 m, 9.8.1954, *Imshaug 16669* (MSC) – San Juan Co., summit of Mt. Mellenthin, La Sal Mts., 38°28'N, [109°14'W], 3929 m, 18.8.1954, *Imshaug 16913* (MSC) – Utah Co., summit of Mt. Timpanogos, Wasatch Mts., 40°23'N, [118°38'W] 3655 m, 9.8.1954, *Imshaug 16683, 16700* (MSC). – Washington: Pierce Co., Burroughs Mt., Mt. Rainier National Park, Middle Cascade Mts., 46°55'N, [121°41'W] 2210 m, 6.9.1954, *Imshaug 17372* (MSC).

Argentina. Prov. Tucuman: Valle de Tafí, western slope of Cumbre Poterillo, 3300 m, on schist rock, 24.11.1947, *Lamb 5407* (UPS). – It is a typical specimen with an inspersed hymenium, reduced thallus and with traces of atranorin & zeorin ('chemotype I' of KNOPH & LEUCKERT 1994). – New to Argentina. Chemotype I was not previously reported south of Mexico.

Lecidella stigmatea (Ach.) Hertel & Leuckert

HERTEL & LEUCKERT, Willdenowia 5: 375 (1969), 6: 251 (1971); HERTEL, Herzogia 2: 56–57 (1970), 2: 256 (1971); HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 334–337 (1977); HERTEL, Mitt. Bot. Staatssamml. München 13: 349–350 (1977), 17: 181–182 (1981), 21: 325 (1985), 28: 226–227 (1989), 30: 315–316 (1991); KNOPH, Bibl. Lichenol. 36: 139–150 (1990); ANDREEV & KUDRATOV, Bot. Zhurn. 77: 109 (1992); THOMSON, American Arctic Lichens 2: 400–402 (1997).

New records:

Figure 8: Distribution of *Lecidella stigmatea* in North America. (Based on specimens seen and on data presented by KNOPH & LEUCKERT 1994).

Iceland. Arnesýsla: Reykjafjall, unmittelbar E von Hveragerði, 64°00'N, 21°11'W, 200–215 m, 30.6. 1979, *Hertel 21246* (M). – Austur-Barðastrandarsýsla: Reykjanesfjall-Halbinsel, Staður, 65°29'N, 21°23' W, küstennahe Basaltklippe, 1 m, 19.7.1979, *Hertel 23050* (M). – Rangárvallasýsla: Thorsmörk, Krossá-Tal, zwischen den Einmündungen des Langadalur und Litlaendagil, 63°41'N, 19°29'W, 240–290 m, 3.7. 1979, *Hertel 21298* (M; infected by *Arthonia intexta* Almqu.), *21303* (M) – Talende des Krossá-Tals, unmittelbar vor der Gletscherzunge des Krossájökulls (Myrdalsjökull), 3.7.1979, *Hertel 21363* (M) – Stakkholtsgjá (von einem Nebenfluß der Krossá durchströmte Schlucht), 63°40'N, 19°33'W, 200 m, 2.7. 1979, *Hertel 21272* (M). – Suður Þingeyjarsýsla (Zentral-Island): Bei Fossgilmosar, 65°06'N, 17°37'W, 680 m, 14.7.1979, *Hertel 21769* (M) – Seljadalur, NNW Reykjahlið, 65°41'N, 16°56'W, 320–370 m, 11. 7.1979, *Hertel 21658* (M) – W-Hang des Tungnafellsjökull, Anstieg zum Gipfel Háhyrna, 64°44'N, 18° 01'W, 1050 m, 15.7.1979, *Hertel 21836* (M).

Greece. Crete: Bezirk Heraklion, Ida-Gebirge, Gipfel des Voulomenon [ca. 35°13'N, 24°46'E], über Kieselkalk, 2150 m, 24.9.1982, *Feuerer & Höhne 12608* (M). – Already mentioned for Crete by HERTEL (1970).

Canada. Alberta: Banff National Park, near Upper Victoria Glacier (near Lake Louise) [51°24'N, 116°14'W] , 13.7.1950, *Imshaug 6919* (MSC, beside *Lecanora marginata*). – Newfoundland: Northern Peninsula section, between Route 73 and shore of Deer Cove, 10 miles south of River of Ponds, west side of Northern Peninsula, 21.7.1967, *R.M. Taylor 1806* (MSC). – Quebec: Gaspe-Est Co., Cap Bon Ami [48°47'N, 64°12'W], [on limestone], VIII.1960, *Imshaug 26451* (MSC).

U.S.A. Arizona: Coconino Co. / Gila Co. (boundary), edge of Mogollon Rim, along AZ 260, 34°18'N, 110°54'W, 2310 m, 9.6.1998, *Hertel 40243* (M) – Gila Co., Tonto National Forest, steep cliffs at the first crossing of the East Verde River above the Flowing Springs Road, 34°18'N, 111°21'W, 1450 m, 9.6. 1998, *Hertel 40257* (M) – Greenlee Co., Apache National Forest, Bear Wallow Wilderness, along trail 63, 33°36'N, 109°25'W, 2600–2680 m, 7.6.1998, *Hertel 40107* (M). – Pima co., Santa Catalina Mtns, Marshal Gulch area, 32°26'N, 110°45'W, 2280–2340 m, 3.6.1998, *Hertel 40017, 40018* (M). – Colorado: Gunnison Co., summit ridge above Cottonwood Pass, Sawatch Mts., 38°51'N, 106°25'W, 3870 m, 31.7. 1952, *Imshaug 11641* (MSC) – Gunnison Co., ridge of Avery Peak, Elk Mts., 38°59'N, [106°58'W], 3765 m, 5.7.1952, *Imshaug 10567, 10577* (MSC) – Lake Co., meadow on Mt. Massive, Sawatch Mts., 39°11'N, [106°28'W], 3885 m, 2.8.1952, *Imshaug 11917* (MSC) – Pitkin Co., meadow at Independence Pass, Sawatch Mts., near Aspen, 39°07'N, [106°34'W] 3690 m, 29.7.1952, *Imshaug 11548* (MSC) – Summit Co./Park Co., Hoosier Ridge, Park Range, 39°22'N, [106°00'W], 8.7.1956, 3960 m, *Imshaug 19039*, 19047, and 4050 m, *Imshaug 19054* (MSC) – San Miguel/Dolores Co., summit of Black Face, San Miguel Mts., 37°50'N, [107°55'W], 3688 m, 24.8.1954, *Imshaug 17179* (MSC). – Idaho: Benewah Co., Plummers Point, Chatcolet Lake, [47°21'N, 116°45'W], 2.5.1954, *Imshaug 16453* (MSC). – Montana: Powell Co., summit of Mt. Powell, Flint Creek Range, 3113 m, 28.8.1955, *Imshaug 18798* (MSC). – New Mexico: Taos Co., summit of Gold Hill, Sangre de Cristo Range, 36°38'N, [105°27'W], 3860 m, 10.8.1952, *Imshaug 12344, 12353, 12365* (MSC). – Utah: Duchesne Co., Uinta Mts., bench near summit of Bald Mt., 40°42'N, [110°54'W], 3445 m, 11.8.1954, *Imshaug 16797* (MSC, next to *Lecidea atrobrunnea*) – Duchesne Co./Summit Co., summit of Bald Mt., Uinta Mts., 3640 m, 11.8.1954, *Imshaug 16728* (MSC) – Juab Co., summit of Mt. Nebo, Wasatch Mts., 39°49'N, 3618 m, 14.8.1954, *Imshaug 16830* (MSC) – Uintah Co., summit of Marsh Peak, Uinta Mts., 40°43'N, [109°49'W], 3724 m, 29.8. 1954, *Imshaug 17290* (MSC) – Uintah Co., summit of Leidy Peak, Uinta Mts., 40°46'N, [109°50'W], 3660 m, 28.8.1954, *Imshaug 17197* (MSC). – Wyoming: Albany Co., summit of Medicine Bow Peak, [41°21'N, 106°19'W], Medicine Bow Mts., 3660 m, 4.7.1956, *Imshaug 18899* (MSC) – Teton Co., Grand Teton National Park, summit of Static Peak, [43°40'N, 110°48'W], 3440 m, 28.8.1950, *Imshaug 9357* (MSC) – Teton Co., Grand Teton National Park, S end of Leigh Lake [43°49'N, 110°44'W], 2100 m, 25. 8.1950, *Imshaug 9073* (MSC) – Park Co.,Yellowstone National Park, summit of Mt. Washburn, 48°58'N, 110°25'W, 3140 m, 31.8.1950, *Imshaug 9451, 9455* (MSC) – Sublette Co., ridge of Mt. Lester [43°03'N, 109°37'W] above Seneca Lake, Wind River Range, 3565 m, 14.7.1956, *Imshaug 19095* (MSC). – Not mentioned for Utah by KNOPH & LEUCKERT (1994), in contrast to ST. CLAIR et al. (1991).

Argentina. Provincia de Mendoza: Campo El Alamo, 20 km E Los Molles, 69°55'W, 35°13'S, on acid rock, 1500 m, 16.3.1989, *Nash 27544* (ASU). – Not mentioned for the province of Mendoza by KNOPH & LEUCKERT (1994).

Miriquidica deusta (Stenh.) Hertel & Rambold

HERTEL & RAMBOLD, Mitt. Bot. Staatssamml. München 23: 380, 383 (1987) ≡ *Lecidea deustata* Zahlbr., Catal. Lich. Univ. 3: 754 (1925) nom. nov.; Massé, Rev. Bryol. Lichenol. 39: 175–180 (1973) ≡ *Semilecanora deusta* (Stenh.) Motyka, Porosty (Lichenes), tom II, rodzina Lecanoraceae: 322 (1996).

New records:

New Zealand. Westland: Two Thumbs Peak, 43°07'S, 170°13'E, Rangitata Valley, stable broken rock at summit of high peak, 2542 m, 8.4.1966, *Fineran 3034* (CANU, in small thalli beside *Lecidea lapicida* and *Tremolecia atrata*; published by FINERAN & DODGE (1970) as *Lecidea atrofuscula* Dodge). Already recorded for New Zealand (FRYDAY 2000).

U.S.A. Nevada: Washoe Co., 2.5 miles south of Pyramid Lake on Nev. 33, 44°04'N, 119°34'W, 1340 m, 14.6.1967, *Wetmore 16698* (MIN). – New to U.S.A. For America there was only a record (based upon a "cf."-determination) by AHTI et al. (1973) for the Northwest Territories (Canada).

Miriquidica garovaglii (Schaer.) Hertel & Rambold

HERTEL & RAMBOLD, Mitt. Bot. Staatssamml. München 23: 384 (1987); HERTEL, Mitt. Bot. Staatssamml. München 30: 316–317 (1991); ANDREEV & MYRZKULOVA, Bot. Zhurn. 77: 118 (1992); WIRTH, Flechten Baden-Württembergs 2: 591 (1995; macrophoto!) ≡ *Lecidea garovaglii* Schaer., Enum. Crit. Lich. Eur. 109 (1850); HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 309-310 (1977); THOMSON, American Arctic Lichens 2: 347–348 (1997).

New records:

Switzerland. Ad saxa micacea in summis Alpium cacuminibus (W; SCHAERER, Lich. Helvet. Exs. 444, as *Lecidea atro-brunnea*).

France. [Dépt. Haute Savoie]: Aux Rousselettes b. Contaminès, 28.8.1856, *Müller Argoviensis* (G).

Italy. Prov. Sondrio: Ad rupes graniticas alpium (M, W; ANZI, Lich. Rar. Langob. Exs. 111, as *Psora atro-brunnea*).

Poland. Ad saxa gneissacea in cacumine montis Schneekoppe Sudetorum, 1863, *Körber* (W; KÖRBER, Lich. Sel. Germ. 281 as *Lecidella atrobrunnea*) – In monte Schneekoppe Sudetorum, *Körber* (W) – Schneekoppe, VIII.1866, *Stein* (W, sub "*Lecidella atrobrunnea*").

Slovakia. Tatra: In valle "Nefftzerka" prope Podbánszko com. Liptó in Hungaria, *Lojka 4438* (W, as *Lecidea atrobrunnea*) – In cacumine alpis Kriván, com. Liptó in Hungaria, *Lojka 4612* (W, as *Lecidea atrobrunnea*).

Romania: In alpis Pareng prope Petroseny, com. Hunyad in Transsylvania, *Lojka 3930* (W), *Lojka 3931*, *Lojka 3933* (W; all under *Lecidea atrobrunnea*). – In cacumine "Sleveju mare" alpis Pareng prope Petroseny, com. Hunyad in Transsylvania, *Lojka 3311* (W, as *Lecidea atrobrunnea*). – In montibus Pirgului, infra alpem Retyezát, com. Hunyad, 31.7.1872, *Lojka 1775* (W, as *Lecidella atrobrunnea*).

Canada. Nunavut: N. Baffin Island, site C-3, 72°34'N, 82°09'W, 370 m, summer 1982, *Scotter 68474* (CANL; as *Lecidea atrobrunnea*).

Within North America *Miriquidica garovaglii* is known from Arctic Canada (THOMSON & al. 1969, THOMSON 1970, THOMSON & SCOTTER 1983, HERTEL 1991), Colorado and Wyoming (ANDERSON 1962, 1964). From Baffin Island ("Eclipse Sound") it was earlier mentioned by HALE (1954).

Miriquidica lulensis (Hellb.) Hertel & Rambold

HERTEL & RAMBOLD, Mitt. Bot. Staatssamml. München 23: 387–388 (1987); HERTEL, Mitt. Bot. Staatssamml. München 30: 317–320 (1991) ≡ *Lecidea lulensis* Hellb., Vetensk. Akad. Förhandl. 463 (1866); THOMSON, American Arctic Lichens 2: 362–363 (1997).

= *Lecidea circumnigrata* H.Magn. var. *reagens* H.Magn. – MAGNUSSON, Bot. Notiser: 410 (1948).

New records:

Svalbard. Spitsbergen: Amsterdamøya, Abbruchkante des Hochplateaus der Insel zum SW-Kap, 79°

46'N, 10°40'E, 260–280 m, 16.7.1975, *Hertel 16132 & Ullrich* (M). – Isfjord: Hotellneset, NW Longyearbyen, Schotterfluren südlich des Flugplatzes [78°14'N, 15°28'E], 20 m, 2.8.1975, *Hertel 16419 & Ullrich* (M). – Kongsfjord: Blomstrandhalvøya, Peirsonhamna [78°58'N, 12°04'E], Vorland an der Küste, 10–50 m, an losen Steinchen, 23.6.1975, *Hertel 16544, 16702 & Ullrich* (M) – Gipfel des Irgensfjellet [78°59'N, 12°09'E], Blomstrandhalvøya, 21.7.1975, *Hertel 16606 & Ullrich* (M) – Vorland SE von Ny Ålesund, zwischen den Gletschern Lovenbreen I und Lovenbreen II [78°54'N, 12°06'E], 12.7.1975, *Hertel 17613* (M).

Iceland. Suður Þingeyjarsýsla: Mývatn, Þrengslaburgir, 65°33'N, 16°51'W, 380 m, 11.7.1979, *Hertel 21650* (M).

Canada. Northwest Territories: Banks Island, [Aulavik National Park], 73°13'N, 119°32'W, 50–55 m, 21.–24.7.1979, *Scotter 30458* (M; accompanist of *Sporastatia testudinea*) – Thelon River, 62°36'N, 104° 50'W, 26.6.1964, *Scotter 3869* (WIS; collection published by SCOTTER & THOMSON 1966 as *Lecidea atromarginata* H.Magn.). – Nunavut: Hood River, Wilberforce Falls area, 1 mile upstream of fall along the west bank of the Hood River, south facing slope of 10°, 67°04'N, 108°46'W, 140 m, 16.8.1990, *Gould 1769* (MIN).

U.S.A. Alaska: At Franklin Bluffs on the Sagavanirktok River, 69°50'N, 148°15'W, 30.7.1958, *Thomson 10860, Shushan & Korunda* (M; tiny accompanist of *Sporastatia testudinea*). Already mentioned for Alaska by HERTEL (1991).

Miriquidica lulensis is an arctic, circumpolar species, in North America extending into the Rocky Mountains (Colorado, ANDERSON & CARMER 1974). Its circumpolar distribution is mapped by HERTEL (1991), where various revised specimens from the Northwest Territories are cited.

Miriquidica pulvinatula (Arnold) Hertel & Rambold

HERTEL & RAMBOLD, Mitt. Bot. Staatssamml. München 23:389 (1987) ≡ *Lecidea pulvinatula* Arnold, Verh. Zool.-Bot. Ges. Wien 29: 382 (1879).

= *Lecidea circumnigrata* H.Magn. var. *circumnigrata* – MAGNUSSON in DEGELIUS, Bot. Notiser 403 (1945); MAGNUSSON, Ark. Bot. 2(2): 113 (1952); HERTEL, Herzogia 2: 39–40 (1970); THOMSON, American Arctic Lichens 2: 335, 337 (1997).

New records:

Iceland. Suður Þingeyjarsýsla (Zentral-Island): Kiðagilsdrög, Schuttflächen an der Piste nach Sprengisandur, 65°03'N, 17°44'W, 780 m, 14.7.1979, *Hertel 21790* (M). – New to Iceland.

Switzerland. Kanton Wallis: Augstbordhorn [46°15'N, 7°49'E] ob Bürchen-Visp, Abhänge zum Ginanzsee, über eisenschüssigem Gneis, 2880 m, 2.9.19... [sic!], *Frey 1513* (G). – From Switzerland presently only known from the Aletschwald area (HERTEL 1970).

Orphniospora moriopsis (A.Massal.) D.Hawksw.

HAWKSWORTH, Lichenologist 14: 135 (1982); HERTEL, Mitt. Bot. Staatssamml. München 30: 321 (1991); THOMSON, American Arctic Lichens 2: 441–442 (1997).

New record:

Canada. Nunavut: Hood River, 1 km W of Hood, near the mouth, area of raised beaches consisting of angular cobbles of red quartzite, 67°25'N, 108°55'W, 30 m, 5.8.1991, *Gould 2122* (MIN).

Poeltiaria corralensis (Räsänen) Hertel

HERTEL, Beih. Nova Hedwigia 79: 431 (1984); HERTEL, Mitt. Bot. Staatssamml. München 21: 310–312 (1985), 23: 330 (1987), 28: 230 (1989); RAMBOLD, Bibl. Lichenol. 34: 268–271 (1989) ≡ *Lecidea corralensis* Räsänen, Revista Univ. (Santiago de Chile) 22: 211 (1937).

New records:

Argentina. Prov. Río Negro: Cenda desda Lago Fria hacia el Ventisquero Frias, en piedras al lado del camino por el bosque, 13.2.1950, *Lamb 6030* (MSC). – Isla Grande (Tierra del Fuego): Cut-over and grazed area at base of cliffs on W side of Río Olivia valley (W of Monte Olivia), along Ruta Nac. No. 3, 54°45'S, 68°13'W, 120 m, 26.11.1971, *Imshaug & Ohlsson 55272* (MSC) – *Nothofagus* forest at S end

of Laguna Escondida, SW side of Hostería Petrel, 54°42'S, 67°46'W, 110 m, 22.11.1971, *Imshaug & Ohlsson 54652* (MSC). Already reported from Argentina by HERTEL (1984, 1987).

Chile. XII Región de Magallanes y de la Antártica Chilena. Prov. de Magallanes, Punta Arenas, Cerros Mina Rica. On stones in naked mineral-soil (solifluction), 550 m, 4.3.1941, *Santesson 6142* (S) – Strait of Magellan, fringe of mossy forest, S shore B. Pond, 53°53'S, 71°51'W, 8.10.1969, *Imshaug & Ohlsson 45335* (MSC) – Brunswick Peninsula, Seno Otway, *Nothofagus* and *Drimys* forest at Bahía Camden, 20.12.1967, *Imshaug & Harris 39076* (MSC). – *Poeltiaria corralensis* is a temperate Southern Hemisphere species, in Chile formerly known only from the provinces of Talca (HERTEL 1970) and Valdivia (type), and from the Juan Fernández Archipelago (HERTEL 1989).

Poeltiaria turgescens (Körb.) Hertel

HERTEL, Beih. Nova Hedwigia 79: 431–432 (1984); HERTEL, Mitt. Bot. Staatssamml. München 21: 326–327 (1985), 28: 230 (1989); RAMBOLD, Bibl. Lichenol. 34: 272–274 (1989).

New record:

New Zealand. Auckland: Kawakawa Bay E of Auckland, Papanui Point, coastal rocks, 36°56'S, 175° 13'E, 8.1.1985, *Mayrhofer 5900 & Samuels* (GZU). – *Poeltiaria turgescens* is a rather common lichen in the North Island of New Zealand.

Poeltidea perusta (Nyl.) Hertel & Hafellner in Hertel

HERTEL, Beih. Nova Hedwigia 79: 463 (1984); HERTEL, Mitt. Bot. Staatssamml. München, 23: 330–331 (1987), 28: 230 (1989); RAMBOLD, Bibl. Lichenol. 34: 275–277 (1987) ≡ *Lecidea perusta* Nyl. in Crombie, J. Bot. (London) 13: 334 (1875).

New records:

Chile. XII Región de Magallanes y de la Antártica Chilena. Prov. de Magallanes: Strait of Magellan, moorland at ridge, W side of B. Borja, 53°32'S, 72°30'W, 7.10.1969, *Imshaug & Ohlsson 45213* (MSC, as *Rhizocarpon simplicisporum* Imshaug nom. ined.). New to Chile.

Argentina. Isla de los Estados: Puerto Cook, alpine summit of mountain at SE corner of bay, 54°46'S, 64°01'W, 23.10.1971, *Imshaug & Ohlsson 51541, 51558* (MSC) – Puerto Vancouver, summit of ridge E of Monte Tres Puntas, 54°47'S, 64°06'W, 29.10.1971, *Imshaug & Ohlsson 52239* (MSC) – Puerto Celular, subalpine summit of peak on N side of cove, 54°47'S, 64°18'W, 490 m, 31.10.1971, *Imshaug & Ohlsson 52579* (MSC) – Puerto Alexander, alpine summit of sea cliffs opposite Islote Alexander, 54°51' S, 64°24'W, 520 m, 2.11.1971, *Imshaug & Ohlsson 52788* (MSC) – Bahía Capitan Canepa, rock outcrop on ridge at head of N arm of bay, 54°49'S, 64°27'W, 4.11.1971, *Imshaug & Ohlsson 53148* (MSC) – Bahía Flinders, exposed rock with small *Nothofagus antarctica* on ridge summit at head of W part of bay, 54°49'S, 64°36'W, 210 m, 7.11.1971, *Imshaug & Ohlsson 53431* (MSC) – Puerto Parry, subalpine summit of Monte Fitton, on W side of entrance to inner bay. 54°47'S, 64°23'W, 456 m, 10.11.1971, *Imshaug & Ohlsson 53875* (MSC). New to Isla de los Estados. – Isla Grande (Tierra del Fuego): Alpine region on summit of mountain to the E of Monte Olivia, 54°43'S, 68°07'W, Sierra de Sorondo, 970 m, 28. 11.1971, *Imshaug & Ohlsson 55587, 55606* (MSC) – Barren alpine region on summit of mountain between Monte Cornu & Paso Garibaldi, Sierra Lucas Bridges, 54°42'S, 67°45'W, 900 m, 27.11.1971, *Imshaug & Ohlsson 55397* (MSC) – Bahía Buen Suceso, alpine region of summit of mountain behind bay, 54°48'S, 65°17'W, 600 m, 12.10.1971, *Imshaug & Ohlsson 49998* (MSC) – Bahía Valentín, krummholz area at summit of mountain behind bay, 54°53'S, 65°32'W, 500 m, 15.10.1971, *Imshaug & Ohlsson 50282* (MSC). Already reported from Tierra del Fuego (HERTEL 1987, 1989).

Falkland Islands (= Islas Malvinas). All the specimens mentioned in the following for the Falkland Islands were correctly recognized by H.A. Imshaug, who provisionally named this taxon "*Lecideocarpon perustum* (Nyl.) Imshaug", as he early and independently realized its unique taxonomic position. Unfortunately his results were never published.

West Falklands: Mt. Adam, feldmark at summit ridge, [51°35'S, 60°09'W], 2200–2297 ft, 25.1.1968, *Imshaug & Harris 41060, 40168, 41088a* (MSC) – Mt. Adam, outcrops on summit of southernmost peak, 685 m, 25.1.1968, *Imshaug & Harris 41095, 41099* (MSC) – Hill Cove, on summit of Mt. Fegen, UTM, 21F TC 7289, 1100–1181 ft, 26.1.1968, *Imshaug & Harris 41209* (MSC) – Port Howard, feldmark and outcrop at summit of Mt. Maria [51°37'S, 59°25'W], 658 m, 28.1.1968, *Imshaug & Harris*

41315, 41316, 41371a, 41372b, 41380, 42190 (MSC) – Port Howard, outcrops on pass SW of Mt. Maria summit, 610 m, 28.1.1968, *Imshaug & Harris 42190* (MSC) – Port Howard, stone-run at E base of Mt. Maria, 381 m, 28.1.1968, *Imshaug & Harris 41415a* (MSC) – Port Howard, large outcrops, Freezers

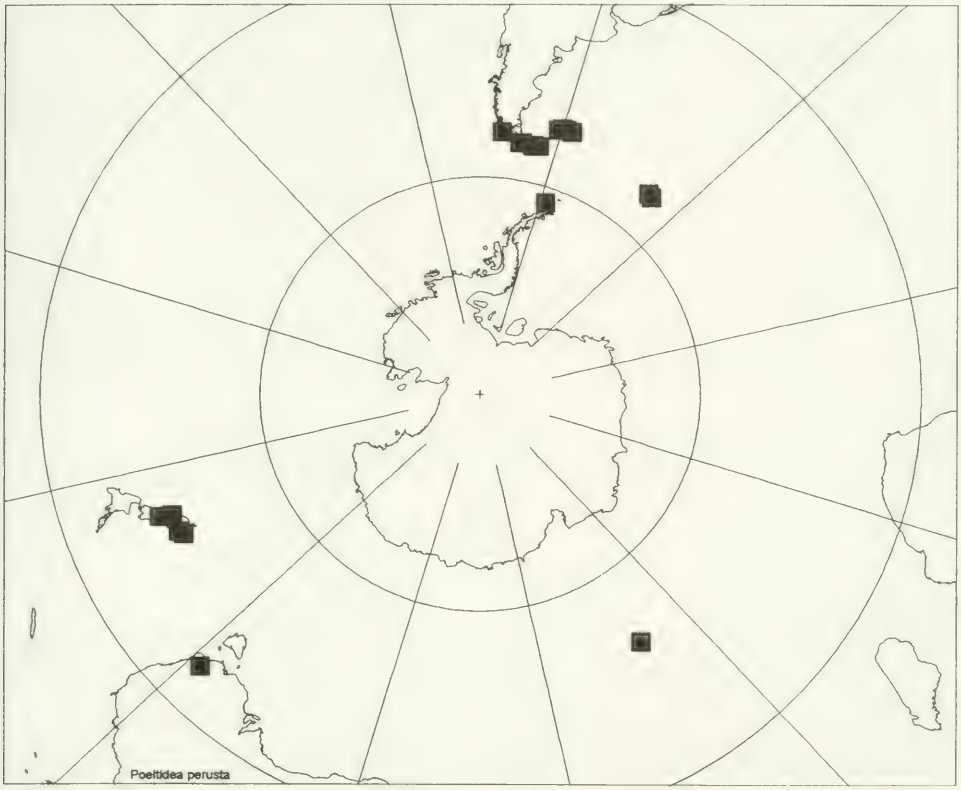

Figure 9: Distribution of *Poeltidea perusta*. Map based on studied specimens (except records from South Shetland Islands, Antarctica, published by OLECH 1989 and INOUE 1993).

Rocks, UTM 21F UC 2279, 320 m, 28.1.1968, *Imshaug & Harris 41345* (MSC) – Weddell Island, *Empe trum* heath at summit of Mt. Weddell, 383 m, 6.2.1968, *Imshaug & Harris 41932, 41949* (MSC) – Weddell Island, stone-run at top of stream in Waterfall Valley, W of settlement, 245 m, 5.2.1968, *Imshaug & Harris 41909* (MSC) – Weddell Island, rock dome at summit of peak NE of Mt. Weddell [51°56'S, 60°52'W], 335 m, 6.2.1968, *Imshaug & Harris 41971* (MSC) – Fox Bay, outcrops on ridge NE of Sullivan House, 150 m, 11.2.1968, *Imshaug & Harris 42344* (MSC). – East Falklands: Mt. Usborne [51°42'S, 59°49'W], stone-run below The Gap, 90 m, 8.1.1968, *Imshaug & Harris 40053* (MSC) – Mt. Usborn, feldmark on windward side of Mt. Usborne-1 summit, 700 m, 7.1.1968, *Imshaug & Harris 39968b* (MSC) – Mt. Usborn, feldmark on leeward side of Mt. Usborne-1 summit, 700 m, 7.1.1968, *Imshaug & Harris 39920, 39921, 39932, 39938a, 39947b* (MSC) – Mt. Usborne, sheltered cliffs with seepage on ridge between Mt. Usborne-1 and Mt. Usborne-2, 685 m, 7.1.1968, *Imshaug & Harris 39988, 39991, 39999* (MSC) – Mt. Usborne, outcrops on summit of Table Rock, 549 m, 9.1.1968, *Imshaug & Harris, 40071, 40079, 40086b, 40125* (MSC) – Stanley, cliffs on rock dome at summit of Mt. Kent [51°41'S, 58°07'W], 460 m, 14.1.1968, *Imshaug & Harris 40428, 40454a, 40490* (MSC) – Stanley, outcrops on summit ridge of N peak of Two Sisters, 800–950 ft, 13.1.1968, *Imshaug & Harris 40328, 40396b, 40409* (MSC) – Stanley, outcrops on summit of ridge of Mt. Harriet, 850-900 ft, 30.1.1968, *Imshaug & Harris 41546* (MSC).

Îles de Kerguélen. Péninsule Courbet, summit of Mt. du Milieu, 740 m, 5.3.1971, *Imshaug 48845* (MSC). The species is described from Îles de Kerguélen.

Porpidia albocaerulescens (Wulfen) Hertel & Knoph ssp. ***albocaerulescens***

HERTEL, Beih. Nova Hedwigia 79: 433–434 (1984); HERTEL & KNOPH, Mitt. Bot. Staatssamml. München 20: 467–485 (1984); RAMBOLD, Bibl. Lichenol. 34: 278–281 (1989); GOWAN, Bryologist 92: 35–38 (1989); WIRTH, Flechten Baden-Württembergs 2: 767 (1995; colour macrophoto!); MALCOLM & GALLOWAY, New Zealand Lichens: 53 (1997; black-and-white macrophoto); MAKAROVA in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 142–143 (1998) ≡ *Huilia albocaerulescens* (Wulfen) Hertel, Herzogia 3: 373 (1975); HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 204–210 (1977); INOUE, J. Jap. Bot. 58: 120–124 (1983).

New records:

Russia. Забайкаьская област [Trans-Baikal region:], Акшинскiи уъздъ [district Akshinsk], окрестпости посёлка Букукупсаго [surroundings of Bukukun, 49°27'N, 111°07'E], 1910, *Mikhno* (W). – Far East, Primorje District: Chasan, in the vicinity of the station of TIBOH, on seashore rocks, 30.9.1983, *Randlane 308* (M) – Road from Yasnaje to Lazo (5 km from Lazo), on a mossy rock, 20.9.1983, *Randlane 187* (M). From Asian parts of Russia *Porpidia albocaerulescens* was reported from Baykalskiy Khrebet (MAKAROVA 1998) and from Sakhalin (HERTEL 1977, MAKAROVA 1998).

Outside of Europe (map: HERTEL & KNOPH 1984) *Porpidia albocaerulescens* s.str. is very widespread and locally very common in mild to warm and humid climates. GOWAN (1989) mapped its distribution in North America, INOUE (1983, 1994) in Japan, HERTEL (1985) in New Zealand, RAMBOLD (1989) in Australia and HERTEL (1987) in Australasia.

Porpidia grisea Gowan

GOWAN, Bryologist 92: 48 (1989); THOMSON, American Arctic Lichens 2: 493 (1997); MAKAROVA in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 147–148 (1998).

New record:

Canada. Nunavut: Cornwallis Island, eastern shore, Resolute Bay, 74°43'N, 94°34'W, on calcareous sandstone, 21.8.1947, *Innes-Taylor 105* (CANL). – The record was published by THOMSON (1960) under the name *Lecidea confluens*.

Porpidia grisea is known from arctic and boreal North America (GOWAN 1989), from the Alps (HERTEL 1992), Fennia and adjacent parts of Russia (GOWAN & AHTI 1993).

Porpidia nadvornikiana (Vězda) Hertel & Knoph

HERTEL & KNOPH in HERTEL, Beih. Nova Hedwigia 79: 437 (1984); SÁNCHEZ-BIEZMA & LÓPEZ DE SILANES, Lichenologist 31:637–639 (1999) ≡ *Haplocarpon nadvornikianum* Vězda, Preslia 44: 209–212 (1972).

Rediscovered material:

Czech Republic. Moravia septentrionalis: Ad rupes serpentinicas prope Raškov apud Šumberk, ca. 450 m, VIII.1921, *Suza* (W).

This collection, labelled "*Lecidea isidiata*" by SUZA (a name which remained unpublished), is from the original locality of *Haplocarpon nadvornikianum*. VĚZDA (1972) already studied material, which was collected by SUZA from this very locality (in 1931), however this material deposited in Prague (PR), was fragmentary and poor. The collection in W, however, is a very fine and typical specimen.

Porpidia speirea (Ach.) Kremp. s.str.

KREMPELHUBER, Denkschr. Bayer. Bot. Ges. 4(2): 210 (1861); GOWAN, Bryologist 92: 51–53 (1989); GOWAN & AHTI, Ann. Bot. Fennici 30: 69 (1993); THOMSON, American Arctic

Lichens 2: 496–497 (1997) ≡ *Lecidea speirea* (Ach.) Ach., HERTEL, Beih. Nova Hedwigia 24: 51–55 (1967); HERTEL, Herzogia 3: 386–397 (1975); INOUE, J. Sci. Hiroshima Univ., ser. B, div. 2 (Botany) 18: 43–45 (1982); MAKAROVA in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 152–154 (1998).

New record:

Norway. Sör Tröndelag: Dovrefjell, Vinstradal SE Driva Kro, Gem. Oppdal, Abbrüche schwach kalkhaltiger Schiefer nördlich Ryphusseter, 1030 m, 4.9.1976, *Buschardt & Poelt* (GZU).

In Scandinavia *Porpidia speirea* s.str. is not often collected. It is reported from Dovrefjell by HERTEL (1967).

Porpidia zeoroides (Anzi) Knoph & Hertel

KNOPH & HERTEL in HERTEL & KNOPH, Mitt. Bot. Staatssamml. München 20: 477 (1984); GOWAN, Bryologist 92: 56–57 (1989); GOWAN & AHTI, Ann. Bot. Fennici 30: 72–73 (1993); THOMSON, American Arctic Lichens 2: 499–501 (1997); MAKAROVA in ANDREEV, KOTLOV & MAKAROVA (eds.), Opredel. Lishayn. Rossii 7: 156–157 (1998).

= *Lecidea macrocarpa* var. *trullisata* (Arnold) Migula; HERTEL, Beih. Nova Hedwigia 24: 65–67 (1967); HERTEL, Mitt. Bot. Staatssamml. München 13: 338–339 (1977).

New record:

Switzerland. Kanton Graubünden: Samnaun, Alp-Trida-Sattel [46°59'N, 10°21'E], oberhalb Compatsch, westlich oberhalb der Bergstation der Seilbahn, 2500 m, über Kalk, 27.7.2000, *Albertshofer* (M).

Psorinia conglomerata (Ach.) Gotth. Schneider

SCHNEIDER, Bibl. Lichenol. 13: 130–133 (1979); THOMSON, American Arctic Lichens 2: 513–514 (1997) ≡ *Lecidea conglomerata* Ach., Lichenogr. Univ. 210 (1810) ≡ *Toninia conglomerata* (Ach.) Boistel, Nouv. Fl. Lich. 2: 105 (1902); LAMB, Rhodora 56: 137–139 (1956); TIMDAL, Opera Bot. 110: 27, 122 (1991).

New records:

U.S.A. Arizona: San Francisco Mts., Coconino Co., summit of Agassiz Peak, 35°20'N, [111°40'W], 3760 m, 7.7.1955, *Imshaug 17882* (MSC) – Mt. Humphreys, south side, [35°20'N, 111°40'W], 3720 m, 10.7.1973, *Nash 8398* (COLO).

Both specimens were misidentified as *Lecidea atrobrunnea*, thus indicating that they represent morphodemes with a somewhat atypical gross morphology. THOMSON & NASH (1976) reported *Toninia conglomerata* as new to North America. The record was based upon a duplicate collection of "*Nash 8398*"; the specimen in COLO however remained without a revision-label. Later THOMSON & SCOTTER (1992) added a first record for Canada (Cape Parry, NWT). So, in contrast to its occurence in the Alps, *Psorinia conglomerata*, which prefers cool and humid regions (POELT & VĚZDA 1981), seems to be a rare lichen in North America.

Rhizocarpon bolanderi (Tuck.) Herre

HERRE, Proc. Washingt. Acad. Sci. 12: 106 (1910); FEUERER, Bibl. Lichenol. 39: 72–74 (1991); THOMSON, American Arctic Lichens 2: 525–526 (1997).

New records:

Canada. Alberta: Jonas Rockslide, 47 miles south of Jasper on Hwy. 93, Icefield Parkway, 52°25'N, 117°23'W, 1600 m, 17.7.1985, *Marsh 1083* (CANL, beside *Lecidea atrobrunnea*). Already reported from Jonas Rockslide by JOHN (1989). – British Columbia: Mt. Cain just N of Schoen Lake, 1800 m, above timber-line on exposed rock, 50°12'N, 126°19'W, 9.8.1969, *Ohlsson 1613* (MSC).

U.S.A. California: Fresno/Inyo Co., Sierra Nevada, above Piute Pass, 37°15'N, 118°41'W, 3660 m, 14.7.1955, *Imshaug 18068* (MSC) – Mariposa Co., Yosemite National Park, above Tenaya Lake [37°49' N, 119°27'W] near Tioga Pass. Among rock ledges in burned pine-juniper forest, elev. 8500 ft (2590 m) 24.6.1966, *Wetmore 14828* (MIN) *14842* (MIN) – Mono Co., Near Devils Gate Pass (12 miles north of Bridgeport) along US 395, 2290 m, 15.6.1967, *Wetmore 16716* (MIN) – San Diego Co., West of Anza-

Borrego State Park on county highway S2 between Calif. 79 and Calif. 78, on gentle north facing slope, 915 m, 22.6.1967, *Wetmore 16932* (MIN) – At campground 1 mile NW of Descanso [32°51'N, 116°36' W], north of US 80, on south facing hillside, 1040 m, 23.6.1967, *Wetmore 16974b* (MIN). – Colorado: Moffat Co., Blue Mt., just south of Yampa Bench road. North facing slope, in Sec. 25, T6N, R101W, on sandstone, 2005 m, 17.7.1960, *MacLeod* (COLO L–33143, as *Lecidea atrobrunnea*–this specimen has many well-developed semiglobular, black pycnidia of 60–100 μm diam., partially immersed in the prothallus, with bacilliform conidia, 8–*10.3*–12 × ± 1 μm; neither FEUERER (1991) nor GELTING (1954) mentioned pycnidia). – Nevada: Washoe Co., 2.5 miles south of Pyramid Lake on Nev. 33, on rock outcrop with sage brush at base, 1220 m, on slightly calcareous volcanic rock, 14.6.1967, *Wetmore* 11681, 16687 (MIN). – Oregon: Baker Co., Magpie Peak, 44°55'N, 117°40'W, ca. 20 km NE of Baker, 1986, *Palmer 22048* (ASU, adjacent *Lecidea atrobrunnea*). – Washington: Mt. Rainier National Park: Rocky area from saddle to summit of Eagle Peak, 1700–1815 m, 1.8.1948, *Imshaug 946* (MSC).

Rhizocarpon dinothetes Hertel & Leuckert

HERTEL & LEUCKERT, Herzogia 5: 27–35 (1979); HAUGAN, Graphis Scripta 3(1): 25 (1990); HAFELLNER, Herzogia 8: 374 (1990).

New record:

Austria. Salzburg: Radstätter Tauern, Mt. Wurmwand, north of the village Obertauern, SE ridge, above the pass Seekarscharte, 47°16'N, 13°34'E, ca. 2100 m, on *Protoparmelia badia*, 14.8.1994, *Hertel 38259* (M). – Not mentioned in TÜRK & WITTMANN's (1987) catalogue of the lichens of Salzburg.

Rhizocarpon pusillum Runem.

RUNEMARK, Opera Bot. 2(1): 63–64 (1956); HERTEL, Herzogia 2: 59 (1970), 4: 386 (1977); HERTEL, Mitt. Bot. Staatssamml. München 12: 146–149 (1975); TÜRK & HAFELLNER, Carinthia II 103: 739 (1993; photo!); THOMSON, American Arctic Lichens 2: 596–547 (1997).

New records:

Svalbard. Spitsbergen: Haakon-VII-Land, Germaniahalvøya, orographisch rechte Seitenmoräne des Lernerbreen an der Südküste des Liefdefjord, kleiner Vogelblock am Kamm der älteren Moräne, ca. 250 m, 13.8.1991, *Schuhwerk 91/935* (M, on *Sporastatia testudinea* beside *Lecidea atrobrunnea*). – There is only a small number of Svalbard records of this tiny, lichenicolous species (HERTEL & ELVEBAKK 1996), although the species in the Liefdefjord area is not rare (F. Schuhwerk, pers. comm.).

Switzerland. Kanton Tessin: Val Piora (NE oberhalb Piotta bei Airolo), kleiner Felsrücken südlich unterhalb des Piz Curnera, zwischen Lago di dentro und Lago Scuro, [46°34'N, 8°42'E], 2450 m, 31.8. 1984, *Hertel 25756* (M, on *Sporastatia testudinea*). – Kanton Wallis: Gornergrat ridge [45°59'N, 7°47'E], 3110 m, 20.7.1961, *Thomson 9375 & Frey* (on *Sporastatia testudinea*, WIS).

U.S.A. Arizona: Coconino Co, San Francisco Peaks, scree slope high above crossing of Abineau Trail and old secondary road, 35°21' N, 111°41' W, 3500 m, 12.6.1998, *Hertel 40010* (M). Already reported from San Francisco Peaks by NASH & al. (1998). – Colorado: Summit of West Spanish Peak, Sangre de Cristo Range, 37°23'N, [104°59'W], 4152 m, 6.8.1952, 8.8.1952. *Imshaug 12069* (on *Sporastatia testudinea* beside *Tephromela armeniaca* (DC.) Hertel & Rambold, MSC) – Gunnison Co., summit ridge of White Rock Mt., Elk Mts., 38°59'N, [106°55'W], 3960 m, 13.7.1952, *Imshaug 11000* (MSC, a tiny infection on thallus of *Sporastatia testudinea*). – Wyoming: Park Co., Beartooth Pass, [44°58'N, 109°28'W], between Red Lodge and Cooke City, 3350 m, 1.9.1950, *Imshaug 9661* (MSC, small thallus on *Sporastatia testudinea*).

Rimularia impavida (Th.Fr.) Hertel & Rambold

HERTEL & RAMBOLD, Mitt. Bot. Staatssamml. München 23: 391 (1987); Bibl. Lichenol. 38: 176–179 (1990) = *Lecidea impavida* Th.Fr., Kongl. Svenska Vetensk. Handl. 7: 42 (1867); THOMSON, American Arctic Lichens 2: 352, 354 (1997).

New records:

Russia. Western Chukotka: Middle stream of the river Rau-Chua near the settlement Baraniha [68°29' N, 168°14'E], in stone field of a montane slope, 17.7.1971, *Makarova 71100* (M, beside *Sporastatia testudinea*). Already mentioned for Chukotka by HERTEL & RAMBOLD (1990).

Canada. Nunavut: [Melville Peninsula]: Repulse Bay, 66°32'N, 86°15'W, 2–10 m, on granite pebble, 5.8.1984, *Scotter 76776* (M, beside *Rhizocarpon inarense*). – Already mentioned for Nunavut (THOMSON & SCOTTER 1983, HERTEL & RAMBOLD 1990).

Rimularia insularis (Nyl.) Rambold & Hertel

RAMBOLD & HERTEL in HERTEL, Lecideac. Exs., fasc. VIII, no. 159 (1985); HERTEL, Mitt. Bot. Staatssamml. München 21: 314-316 (1985); RAMBOLD, Bibl. Lichenol. 34: 304-307 (1989).

New records:

Canada. Saskatchewan: Lake Athabaska, 5 miles east of Poplar Pt., South Shore, First Camp, 59°30' N, 107°41'W, 24.7.1935, *Raup 2046* (M, on *Lecanora rupicola* s.l.; filed under *Schaereria fuscocinerea*).

U.S.A. Alaska: 10 miles N of Jago Lake at Jago River, 69°45'N, 143°42'W, 300 m, crest of ridge of sandstone outcrop (possibly nunatak), 31.7.1957, *Cantlon & Gillis 57-1711* (MSC). New to Alaska. – Arizona: Apache Co., White Mtns, Mt. Baldy Wilderness, East Fork of Little Colorado River, along trail no. 95 from Phelp's Cabin to Mt. Baldy, 33°56'N, 109°30'W, 2960 m, 8.6.1998, *Hertel 40171, 40182* (M) – Cochise Co., Chiricahua Mtns, Coronado National Forest, between Barfoot Park and Buena Vista Peak, 31°55'N, 109°16'30"W, 2580 m, 4.6.1998, HERTEL 40034 (M) – Coconino Co., summit of Agassiz Peak, San Francisco Mts., 35°20'N, [111°40'W], 3760 m, 27.8.1952, *Imshaug 12729* (MSC) – Coconino Co. (at Gila Co. boundary), edge of Mogollon Rim along AZ 260, 34°18' N, 110°54' W, 2310 m, 9.6. 1998, *Hertel 40209* (M) – Gila National Forest, upper end of Pine Canyon, 34°26'N, 111°24' W, 2235 m, 10.6.1998, *Hertel 40273, 40287, 40295* (M). – Montana: Glacier National Park: Lake McDonald by Fish Creek, [47°25'N, 113°59'W], 975 m, 6.8.1950, *Imshaug 8219* (MSC). – Washington: [Pierce Co.], Mt. Rainier National Park, Mt. Wow, [46°46'N, 121°54'W], 1830 m, 21.8.1948, *Imshaug 1885* (MSC).

Figure 10: Southern hemisphere distribution of *Rimularia psephota*. Map based on studied specimens.

Rimularia psephota (Tuck.) Hertel & Rambold

HERTEL & RAMBOLD in HERTEL, Mitt. Bot. Staatssamml. München 23: 334 (1987); HERTEL & RAMBOLD, Bibl. Lichenol 38: 183–185 (1990) ≡ *Lecidea psephota* Tuck., Proc. Amer. Acad. Arts 12: 181 (1877) ≡ *Lambiella psephota* (Tuck.) Hertel, Beih. Nova Hedwigia 79: 460 (1984).

New records:

Argentina. Isla de los Estados: Cabo San Bartolome, littoral zone on N side of peninsula, 54°54'S, 64°42'W, 5.11.1971, *Imshaug & Ohlsson 53186* (MSC) – Bahía Primera, littoral zone on Cabo Kendall peninsula, 54°49'S, 64°07'W, 30.10.1971, *Imshaug & Ohlsson 52320* (MSC).

Falkland Islands (= **Islas Malvinas**). West Falklands: Hill Cove, cliffs along sea at Point Settlement, UTM Grid 21F TC 8390 [51°30'S, 60°07'W], 27.1.1968, *Imshaug & Harris 41260* (MSC) – Westpoint Island, coastal rocks along NE shore adjacent to Cape Terrible, UTM Grid 21F TD 4006 [51°20'S, 60°41' W], 21.1.1968, *Imshaug & Harris 40776* (MSC) – Weddell Island, coastal rocks along E side of Ottos Bay, UTM Grid 21F TC 3243 [51°54'S, 60°53'W], 7.2.1968, *Imshaug & Harris 42037* (MSC).

Rimularia psephota is a bipolar lichen, which was known from Chile (Prov. de Magallanes; type locality and HERTEL 1989, HERTEL & RAMBOLD 1990), Argentina (Tierra del Fuego; HERTEL 1989), Antarctic Peninsula (HERTEL 1989, HERTEL & RAMBOLD 1990), New Zealand (North and South Island; e.g. HERTEL 1985, 1989), Australia (A.C.T.: RAMBOLD 1989; Tasmania: HERTEL & RAMBOLD 1990), Îles de Kerguélen (HERTEL 1984), Macquarie Island (HERTEL 1987), South Georgia (HERTEL 1989), and arctic Europe (Iceland: HERTEL & RAMBOLD 1990; Spitsbergen, Iceland, Sweden, Novaya Zemlya: HERTEL 1991).

Schaereria fuscocinerea (Nyl.) Clauzade & Cl. Roux

CLAUZADE & ROUX, Bull. Soc. Centre-Ouest, N.S., Numéro Spécial, 7: 829 (1985); RAMBOLD, Bibl. Lichenol. 34: 310–313 (1989); WIRTH, Flechten Baden-Württembergs 2: 849 (1995; macrophoto!)

= *Schaereria tenebrosa* (Flot.) Hertel & Poelt in HAWKSWORTH, JAMES & COPPINS, Lichenologist 12: 107 (1980); THOMSON, American Arctic Lichens 2: 583–584 (1997).

= *Schaereria endocyanea* (Stirt.) Hertel & Gotth. Schneider in Gotth. Schneider, Bibl. Lichenol. 13: 239 (1979); THOMSON, American Arctic Lichens 2: 582–583 (1997).

New records:

Iceland. Suður Þingeyjarsýsla: Myvatn, Umgebung von Skútustaðir, 65°34'N, 17°02'W, 10.7.1979, *Hertel 21636* (M). – Suður Múlasýsla: Felsküste bei Berufjörður, 10 km NW von Djupivogur, 64°44'N, 14°24'W, 30 m, 8.7.1979, *Hertel 21502* (M) – Ca. 1.5 km NW von Djupivogur, 64°40'N, 14°19'W, 20–40 m, 8.7.1979, *Hertel 21516* (M) – Paßhöhe Breiðdalsheiði, an der Straße von Breiðdalsvik nach Þingmúli, 64°54'N, 14°37'W, 500 m, 9.7.1979, *Hertel 21552* (M). – Mýrasýsla: Am Paß Brekkumuli, 64°52' N, 21°31'W, 390–440 m, 18.7.1979, *Hertel 21960* (M).

Switzerland. Kanton Bern: Guttannen, ober Platti, 1300 m, 12.10.1919, *Frey 269* (G) – Aarboden, 1860 m, 23.7.1918, *Frey 344* (G) – Hochgant, Blockhalde am Südhang über dem Aelgäu, 2000 m, 21.10. 1943, *Frey 1603* (G). – Kanton Graubünden: Scarl, Vallatscha, 2200 m, 1.8.1928, *Frey 317 m* (G) – Fluchthorn Südgipfel [46°53'N, 10°14'E, at the Austrian border], 3399 m, 9.4.1969, *Schuhwerk 927* (M) – Arosa, Weisshorn [46°47'N, 9°38'E], Gipfel, 2640 m, 3.7.1961, *Frey 27304* (G). – Kanton St.Gallen: Molseralp, Ziger [47°04'N, 9°15'E] westlich von Prodchamm, 2070 m, 14.7.1965, *Frey 28373* (G). – Kanton Tessin: Val Piora, Bergrücken "Motta" SE oberhalb Alpe Tom (zwischen Lago di Tom und Lago Ritóm), [46°33'N, 8°41'E], 2100 m, 1.9.1984, *Hertel 25806* (M). – Kanton Wallis: Konkordiahütte am Aletschgletscher, 2850 m, 14.7.1921, *Frey* (G).

France. Dépt. Hautes Alpes: Dauphiné, La Bérarde, Vall. des Entançons, 1840 m, 12.8.1932, *Frey 1124 & Schmidt* (G). – Dépt. Lozere: Mont Aigoual, Serre de la Lusette, 1380 m, 27.9.1931, *Frey* (G).

Canada. Alberta: Jasper National Park: Ridge opposite Angel Glacier on Mt. Edith Cavell [52°40'N, 118°03'W], 1980 m, 16.–17.7.1950, *Imshaug 7008, 7059* (MSC, beside *Lecidea lapicida* and *Tremolecia atrata*). – Saskatchewan: Lake Athabaska, 5 miles east of Poplar Pt., South Shore, First Camp, 59°30'N, 107°41'W, 24.7.1935, *Raup 2046* (M).

U.S.A. Arizona: Cochise Co., Chiricahua National Monument, "Heart of Rocks" area, 32°00'N, 109° 19'W, 2060 m, 5.6.1998, *Hertel 40066, 40073* (M) – Gila Co., East Verde River Canyon, upriver from where it intersects with the Houston Mesa Road, ca. 14 km NNE of Payson, 1440–1510 m, 30.5.1998, *Hertel 39704* (M). – Colorado: Larimer Co., Big Thompson River Canyon, from 3 miles W. of Loveland west to Estes Park, 1675–2135 m, VIII.1959, *Fahrenbruch S–24549* (M).

South Africa. Western Cape Prov.: Distr. Wellington: Bains Kloof [33°37'S, 19°06'E], on sandstone rocks, 20.9.1953, *Almborn 5131* (LD). – New to Africa.

Schaereria fuscocinerea is widely distributed in both hemispheres. In the Southern Hemisphere, it was reported from South Georgia (HERTEL 1984) and Australia (RAMBOLD 1989).

Sporastatia polyspora (Nyl.) Grumm.

GRUMMANN, Catal. Lich. Germ. 23 (1963); THOMSON, North American Arctic Lichens 2: 587–588, 590 (1997).

New record:

U.S.A. Alaska: Juneau Icefield, summit ridge of Mt. Moore (cirque wall above Camp 8), knife-edge talus slope at 7000 ft elevation, 26.7.1962, *Imshaug 29066* (MSC).

According to the map given by THOMSON (1997) there is, beside a locality on Attu Island (westernmost Aleutean Islands – TALBOT & al. 1991) no record for Alaska.

Trapelia coarctata (Turner ex Sm. & Sow.) M.Choisy

CHOISY in WERNER, Bull. Soc. Sci. Maroc 12: 160 (1932); THOMSON, American Arctic Lichens 2: 620-621 (1997).

New record:

Chile. **XII Región de Magallanes y de la Antártica Chilena**. Prov. de Magallanes: Península de Brunswick, Punta Arenas, *Nothofagus* woods E of Mina Loreto on S side of Río de las Minas, 215 m, 18. 12.1967, *Imshaug & Harris 38932* (MSC).

Tremolecia atrata (Ach.) Hertel

HERTEL, Khumbu Himal, Ergebn. Forsch.-Unternehmens Nepal Himalaya 6: 351–353 (1977); THOMSON, American Arctic Lichens 626–628 (1997).

New records:

U.S.A. Alaska: 4 miles S of Okpilak Lake, granite talus, 69°22'N, 144°04'W, 915 m, *Canton & Gillis 57–2374, 57-2378* (MSC) – Juneau Icefield, summit ridge of Mt. Moore (cirque wall above Camp 8), knife-edge talus slope at 7000 ft [2133 m], 26.7.1962, *Imshaug 29050* (MSC) – Mt. Juneau [58°19'N, 134°24'W], (vicinity of Juneau), alpine summit area, 1090 m, 15.7.1962, *Imshaug 28688* (MSC). – Washington: Mt. Rainier National Park, Mt. Wow, 21.8.1948, *Imshaug 1929* (MSC).

Argentina. Isla Grande (Tierra del Fuego): Bahía Buen Suceso, alpine region at summit of mountain behind bay, 54°48'S, 65°17'W, 600 m, 13.10.1971, *Imshaug & Ohlsson 50010* (MSC) – Alpine region with occ. cushion plants near summit of mountain between Monte Cornu and Paso Garibaldi, Sierra Lucas Bridges, 54°42'S, 67°45'W, 790 m, 27.11.1971, *Imshaug & Ohlsson 55431* (MSC) – Cut-over and grazed area at base of cliffs on W side of Río Olivia valley (W of Monte Olivia), along Ruta Nac. no. 3, 54°45'S, 68°13'W, 120 m, 26.11.1971, *Imshaug & Ohlsson 55289* (MSC). – Isla de los Estados: Puerto Celular, 54°47'S, 64°18'W, subalpine summit of peak on N side of cove, 490 m, 31.10.1971, *Imshaug & Ohlsson 52565* (MSC) – Puerto Hoppner, wet heath with groves of prostrate *Nothofagus*, on summit of hill behind inner bay, 54°47'S, 64°24'W, 150 m, 9.11.1971, *Imshaug & Ohlsson 53813* (MSC) – Puerto Roca, summit of peak S of bay, 54°46'S, 64°15'W, 360 m, 21.10.1971, *Imshaug & Ohlsson 51132* (MSC) – Puerto Cook, alpine summit of mountain at SE corner of bay, 54°46'S, 64°01'W, 23.10.1971, *Imshaug & Ohlsson 51545* (MSC, a tiny thallus beside *Rhizocarpon* spec.)

Falkland Islands (= **Islas Malvinas**). West Falklands: Fox Bay, outcrops on ridge NE from Sulivan House, UTM Grid 21F TC 8952, 150 m, 11.02.1968, *Imshaug & Harris 42351* (MSC) – Port Howard, feldmark and outcrop on summit ridge of Mt. Maria, UTM Grid 21F UC 2078-2079 [51°37'S, 59°25'W], 610–655 m, 28.01.1968, *Imshaug& Harris 41372* (MSC, small thallus beside *Poeltidea perusta*). – East Falklands: Stanley, cliffs on rock dome at summit of Mt. Kent, UTM Grid 21F VC 2374, 460 m, 14.01.

1968, *Imshaug & Harris 40477* (MSC) – Stanley, outcrop on Sapper Hill, UTM Grid 21F VC 3871 [51° 43'S, 57°53'W], 135 m, 4.01.1968, *Imshaug & Harris 39737* (MSC).

Îles de Kerguélen. Péninsule Courbet, E summit of Mt. du Milieu, 740 m, 5.3.1971, *Imshaug 48819, 48822* (MSC).

Figure 11: Subantarctic distribution of *Tremolecia atrata* (based on specimens seen).

Tremolecia atrata is tiny but usually easily recognizeable species. It is not yet known from continental Antarctica, Bouvet Island, Macquarie Island, Campbell and Auckland Islands and from the North Island of New Zealand. *Tremolecia atrata*, an alpine element, seems to be confined to areas with a humid climate.

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Prof. Dr. Hannes HERTEL, Botanische Staatssammlung München, Menzinger Str. 67, D–80638 München, Germany.
E-mail: hertel@botanik.biologie.uni-muenchen.de

Die Infloreszenzen der Juncaceae

C.P. KÖBELE und H.-J. TILLICH

Zusammenfassung:
KÖBELE, C.P. & TILLICH, H.-J.: Die Infloreszenzen der Juncaceae. – Sendtnera 7: 137–161. 2001. ISSN 0944–0178.

Es wird der Infloreszenzbau von Vertretern aller Gattungen der Juncaceae s.l. (*Juncus*, *Luzula*, *Prionium*, *Marsippospermum*, *Rostkovia*, *Distichia*, *Oxychloe* und *Patosia*) analysiert. In der Literatur wurden die Blütenstände der Familie bisher mit Begriffen wie z.B. Rispe (Panicula), Trichterrispe (Spirre, Anthela) oder Drepanium (Sichel) beschrieben. Da diese Termini monotelen Synfloreszenzbau suggerieren, wird der Frage nachgegangen, ob bei den Juncaceen tatsächlich monotele Synfloreszenzen vorkommen. Bei *Prionium* und bei *Juncus* subgen. *Juncus* ist polyteler Bau offenkundig, da die Baueinheiten (Floreszenzen) des Blütenstandes mehrblütige, offene Ähren bzw. Köpfchen darstellen. In *Juncus* subgen. *Poiophylli* sowie bei allen anderen Gattungen finden sich distal an jeder Achse Einzelblüten, die an ihrer Basis von zwei Brakteen begleitet werden. Diese Blüten wurden bisher als terminal, die sie begleitenden Brakteen als Vorblätter bezeichnet. Es werden jetzt Befunde vorgelegt, die diese Einzelblüten mitsamt ihren Brakteen eindeutig als einblütige, terminal offene Ährchen ausweisen. Damit ist für die gesamte Familie polyteler Synfloreszenzbau nachgewiesen. Reduktionstendenzen führen einerseits zur Beschränkung der Blütenbildung auf die Hauptfloreszenz (mehrblütig z.B. bei *Juncus triglumis*, einblütig bei *Marsippospermum* und *Rostkovia*), andererseits zur Prolifikation und Blütenbildung nur noch an Paracladien (*Oxychloe*, *Patosia* und *Distichia*). Bei *Luzula* sect. *Gymnodes* sind die Paracladien differenziert in distale Kurzparacladien, die zu einem Ährchen 2. Ordnung zusammentreten, und proximale Langparacladien, die das Verhalten der distalen Region der Hauptachse wiederholen. Das Achsensystem des Gesamtblütenstandes ist bei *Prionium* dem einer monotelen Kegelrispe analog, die Infloreszenz muss korrekt als Paniculodium bezeichnet werden. Bei reicher verzweigten *Juncus*-Arten sowie bei den Sektionen *Anthelaea* und *Pterodes* von *Luzula* entspricht das Achsensystem der Infloreszenz dem einer monotelen Trichterrispe, der Blütenstand ist ein Anthelodium.

Das Drepanium ist ein Spezialfall des Verzweigungsmusters eines Paracladiums. Es entsteht durch die monochasiale Verkettung von Sympodialgliedern, die jeweils außer einem adossierten Vorblatt nur ein weiteres Blatt und distal ein einblütiges Ährchen tragen. Das Drepanium wurde nur in den Sektionen *Caespitosi* und *Tenageia* von *Juncus* gefunden.

Infloreszenzen nach dem Muster des Paniculodiums und des Anthelodiums, die starke Tendenz zur Bildung einblütiger Ährchen und deren Zusammentreten zu Ährchen 2. Ordnung stimmen bis in viele Details mit den entsprechenden Mustern der Cyperaceae überein.

Abstract:
A detailed analysis of the inflorescence structure of members of all genera of Juncaceae s.l. is presented (*Prionium, Juncus, Luzula, Marsippospermum, Rostkovia, Oxychloe, Patosia, Distichia*). In the literature the inflorescences of the family are mostly interpreted as panicles or anthelas, details are described using vaguely defined terms as cymose, racemose, or drepanium. Most of these terms suggest a monotelic structure of the inflorescence, which would be very unusual among derived Monocots. This problem stimulated the present study. The basic elements of the inflorescence in *Prionium* and *Juncus* subgen. *Juncus* are many-flowered, terminally open spikelets or small heads (fig. 13a). In these cases the complete system is undoubtedly a polytelic synflorescence. In *Juncus* subgen. *Poiophylli* and in all the other genera the main axis, as well as all branches, bear a distal, solitary flower embraced with two bracts. This structure represents an one-flowered spikelet. The only flower develops in the axil of the lower bract and takes a pseudoterminal position. The axil of the upper bract is empty. These one-flowered spikelets are arranged in *Juncus* subgen. *Poiophylli* and in the sections *Anthelaea* and *Pterodes* of *Luzula* in the same manner as the multi-flowered spikelets in *Prionium* and *Juncus* subgen. *Juncus* (fig. 13b). Thus all members of the family have polytelic synflorescences. At family level several tendencies of reduction of the branching system are found. All paracladia may be suppressed, flowers are developed only in the main florescence, either multi-flowered, e.g. in *Juncus triglumis* (fig. 13d), or one-flowered, as in *Marsippospermum* and *Rostkovia* (fig. 13e). In other cases the main florescence fails to develop, the vegetative main axis grows permanently, and flowers are developed only at paracladia (*Distichia, Rostkovia, Patosia*; fig. 13f). *Luzula* sect. *Gymnodes* has two kinds of paracladia. The distal ones are short paracladia, forming a spike of second order, the proximal ones are long paracladia, which repeat the behaviour of the distal area of the main axis (fig. 13c).

The branching system of the complete inflorescence of *Prionium* is analogous to that of a monotelic panicle, the inflorescence is correctly termed a paniculodium, i.e. the polytelic analogon to the monotelic panicula. The complete inflorescences of most *Juncus* species and of the sections *Anthelaea* and *Pterodes* of *Luzula* are analogous to the monotelic anthela and have to be termed an anthelodium. The drepanium is a specialized case of a branching system of a paracladium. The sympodial elements of it consist of an axis with an adaxial prophyll, one further bract and a distal, obviously always one-flowered, spikelet. In our material we have found a drepanium only in the sections *Caespitosi* and *Tenageia* of *Juncus*. Among Cyperaceae inflorescences similar to those of the Juncaceae are found. These include typical paniculodia, anthelodia, and one-flowered spikelets, which are often crowded forming a spikelet of second order.

1. Einleitung

In der traditionellen Umgrenzung gehören zu den Juncaceae die beiden weltweit verbreiteten Gattungen *Juncus* und *Luzula* sowie die südhemisphärischen Gattungen *Distichia, Marsippospermum, Oxychloe, Patosia, Rostkovia* und *Prionium*. Das in der Kapprovinz endemische *Prionium* wurde kürzlich von MUNRO & LINDER (1998) als monotypische Familie Prioniaceae von den Juncaceae abgetrennt.

Die reichblütigen Infloreszenzen von *Juncus, Luzula* und *Prionium* werden allgemein als Rispe (Panicula) bzw. Spirre (Anthela, Trichterrispe) bezeichnet. Rispe und Spirre sind eindeutig definiert als monotele Synfloreszenzen (vgl. TROLL 1964b, S. 152). Eine erhebliche Verwirrung der Terminologie entsteht durch die Benutzung des Begriffspaares cymos/racemos für die Juncaceen-Blütenstände. NOVARA (1976) beschreibt die Infloreszenzen von *Juncus* Subgenus *Poiophylli* als cymos, die des Subgenus *Juncus* als racemos. Diese Terminologie übernehmen auch SNOGERUP (1993) und BALSLEV (1996). Bezüglich der präzisen Definition und Verwendung der Begriffe cymos bzw. Cyme sei auf die Arbeit von MÜLLER-DOBLIES et al. (1992) verwiesen. BALSLEV (1998) verstärkt die begriffliche Ver-

wirrung noch, wenn er meint, einige *Juncus*-Arten hätten „determinate sympodial panicles" (!). Monotelie ist auch zu vermuten, wenn er angibt: „*Rostkovia* and *Marsippospermum* have a solitary, perfect, terminal flower".

Ein weiteres Problem liegt in dem für einige *Juncus*-Arten so typischen Drepanium (Sichel). MÜLLER-DOBLIES et.al. (1992) haben zwar geklärt, dass dieses sympodiale System nicht zu den Cymen gehört, da die Verzweigung nicht aus der Achsel eines Vorblattes erfolgt. Andererseits bezweifeln sie nicht, dass die distale Blüte jedes Sympodialgliedes eine terminale Position hat und vermuten, dass das Drepanium von einem reicher verzweigten System herzuleiten ist: „the drepanium of *Juncus* has in any case to be derived from richer branched, i.e. paniculate structures with a racemose branching". Die Frage nach der möglichen Monotelie bleibt damit wiederum offen.

Zweifel am Vorkommen von Monotelie bei den Juncaceen ergeben sich zunächst aus der Tatsache, dass die Teilblütenstände einiger *Juncus*-Arten einfache, offene Ähren bzw. Köpfchen (Floreszenzen) darstellen. Diese Arten weisen einen ganz klar polytelen Synfloreszenzbau auf. Es müssten also innerhalb einer Familie und sogar innerhalb einer Gattung monotele und polytele Synfloreszenzen nebeneinander vorkommen.

BUCHENAU (1890) hat die beiden Verzweigungstypen bereits genau erkannt und die Arten der Gattung *Juncus* daraufhin in die informellen Gruppen *Flores prophyllati* und *Flores eprophyllati* untergliedert. VIERHAPPER (1930) blieb bei dieser Gliederung. Erst KIRSCHNER et al. (1999) haben den Sachverhalt nomenklatorisch bereinigt und die Subgenera *Juncus* und *Poiophylli* mit insgesamt zehn Sektionen beschrieben (s. Tab. 1).

Tabelle 1: Die taxonomische Gliederung der Gattung *Juncus* L. (nach KIRSCHNER et al. 1999).
Table 1: The taxonomic subdivision of the genus *Juncus* L. (after KIRSCHNER et al. 1999).

Juncus L. subgenus ***Juncus***	***Juncus*** L. subgenus ***Poiophylli*** Buchenau
1. sect. *Juncus*	7. sect. *Tenageia* Dumort.
2. sect. *Graminei* (Engelm.) Engelm.	8. sect. *Steirochloa* Griseb.
3. sect. *Caespitosi* Cout.	9. sect. *Juncotypus* Dumort.
4. sect. *Stygiopsis* Kuntze	10. sect. *Forskalina* Kuntze
5. sect. *Ozophyllum* Dumort.	
6. sect. *Iridifolii* Snogerup & Kirschner	

Beim Subgenus *Poiophylli* trägt jeder blattachselständige, einblütige Ast ein grundständiges, adossiertes Vorblatt sowie, direkt unter der distalen Blüte, zwei weitere Brakteen, die in der Bestimmungsliteratur fälschlich ebenfalls als Vorblätter bezeichnet werden. Beim Subgenus *Juncus* besitzen die Einzelblüten des mehrblütigen Ährchens keine Blattorgane an ihrem Blütenstiel, sie stehen direkt in der Achsel eines Tragblattes. BUCHENAU (1890) hatte sich schon Gedanken über die phylogenetischen Beziehungen zwischen den beiden Infloreszenztypen gemacht. Er hält zunächst die flachblättrigen Juncaceae für die ursprünglichen Sippen. Die Blüten vieler Arten dieser Gruppe sind durch je zwei Brakteen, die auch BUCHENAU als Vorblätter bezeichnet, eingehüllt. Als spezielle Modifikation findet man in der Gattung *Luzula* z.T. das Phänomen der Trunkation der Hauptachse und, bei manchen Blüten, gleichzeitig den Ausfall der oberen Braktee. BUCHENAU sieht darin ein Indiz für den Übergang vom Infloreszenztyp des Subgenus *Poiophylli* zu dem des Subgenus *Juncus*: „In dieser Richtung ist es nun bedeutungsvoll, dass bei den *Luzula*-Arten, deren Blüten in Ähren oder Köpfchen zusammengedrängt sind, sich eine Neigung zum Schwinden der Vorblätter zeigt. Wenn dieses Schwinden fortschritte, so würden zuletzt vorblattlose Blüten in den Achseln von Hochblättern vorhanden sein. Aus diesem Grund glaube ich annehmen zu dürfen, dass die *Juncus*-Arten mit vorblättrigen Blüten die ältere Gruppe bilden. Ich nehme daher auch an,

dass der Urtypus der Juncaceen vorblättrige Blüten hatte und dass er also den *Juncis poiophyllis* entsprach" (S. 53f.).

Übertragen in die heutige Terminologie bedeutet dies: Der Grundtypus der Infloreszenz der Juncaceen besitzt aus den Achseln von Tragblättern entspringende Paracladien, die an ihrer Basis je ein adossiertes Vorblatt tragen und in einer Terminalblüte enden. Direkt unterhalb dieser Blüte stehen zwei Brakteen. Durch den Ausfall der beiden Brakteen und des Vorblattes, zusätzliche Trunkation der Hauptachse und Verkürzung der Internodien der Seitenäste sind die Ähren bzw. Köpfchen der Untergattung *Juncus* entstanden (Abb. 1a, b). Sie entsprächen damit einer monotelen Rumpfsynfloreszenz.

Das vermeintliche Vorkommen der phylogenetisch ursprünglichen Monotelie inmitten der ganz überwiegend polytelen Monocotylen (Ausnahmen wohl nur bei wenigen Alismatidae und den Burmanniaceae, s. TROLL 1964a, 1969) hat eine gründlichere Untersuchung angeregt. Mit der vorliegenden Arbeit wird versucht, Antwort auf zwei Fragen zu geben:

1. Kommen bei den Juncaceae tatsächlich monotele Synfloreszenzen vor?
2. Welche phylogenetische Beziehung besteht zwischen den verschiedenen Infloreszenzen der Familie?

2. Material und Methoden

Die Untersuchungen erfolgten zum größten Teil an frischen Pflanzen oder an konserviertem Material (70% Ethanol), das von C. P. Köbele 1999–2000 gesammelt worden ist. Von diesen Herkünften wurden Belegexemplare im Herbarium des Instituts für Systematische Botanik der LMU-München (MSB) hinterlegt. Zusätzlich wurde Herbarmaterial aus der Botanischen Staatssammlung München (M) untersucht. Das für die vorliegende Arbeit herangezogene Material ist in Tab. 2 zusammengestellt. Es umfasst alle Gattungen der Familie, aus der Gattung *Juncus* konnten Beispiele aus 8 der insgesamt 10 Sektionen berücksichtigt werden.

Für die morphologischen Analysen und zum Zeichnen wurde ein Stereomikroskop Leica Wild MZ 8 mit Zeichenspiegel verwendet. Die Aufriss-Diagramme der Infloreszenzen wurden mit dem Programm CorelDraw am Computer erstellt. Um die Übersichtlichkeit zu gewährleisten, werden alle Achsen mit gestreckten Internodien dargestellt, Achsenstauchungen und Übergipfelungen bleiben in den Schemata weitgehend unberücksichtigt. Über die verwendeten Symbole gibt Abb. 1c Auskunft. Um die Orientierung in den z.T. sehr komplexen Infloreszenzen zu erleichtern, sind alle Blätter und Blüten der Hauptachse jeweils schwarz ausgefüllt. Rudimentäre Blüten sind nur als Blütenstiel dargestellt.

Tabelle 2: Das Untersuchungsmaterial.
Table 2: The investigated material.

Art	Herkunft und Beleg
Distichia muscoides Nees & Meyen	Bolivien, Depto. La Paz, T. Feuerer & H. Preiss Nr. 4760a, 10.8.1980.
Juncus acutiflorus Ehrh. ex Hoffm.	Deutschland, Bayern, Landkr. FFB, Köbele Nr.23.
Juncus articulatus L. em. Richter	Deutschland, Bayern, Landkr. FFB, Köbele Nr.24 u. 40.
Juncus articulatus L. em. Richter	Marokko, Hoher Atlas, Oukaimeden, Köbele Nr. 31.
Juncus bufonius L.	Deutschland, Bayern, Landkr. FFB, Köbele Nr. 38.
Juncus capensis C. P. Thunberg	Südafrika, Cape Province, W. Griess Nr. 1214, 10.11.1946.
Juncus capitatus Weigel	Deutschland, Bayern, Mittelfranken, O. Prechtelsbauer s. n., Juli 1886.
Juncus capitatus Weigel	Deutschland, Bayern, Unterfranken, Aug. Vill s. n., 8.8.1896.
Juncus castaneus SM.	Österreich, Kärnten, Joh. Drobny s. n., 21.7.1922.
Juncus castaneus SM.	Österreich, Tirol, Merxmüller & Wiedmann s. n., 21.7.1957.
Juncus conglomeratus L. em. Leers	Deutschland, Bayern, Landkr. FFB, Köbele Nr. 11, 18, 19 u. 20.
Juncus inflexus L.	Deutschland, Bayern, Landkr. FFB, Köbele Nr. 6, 10 u. 14.

Art	Herkunft und Beleg
Juncus inflexus L.	Marokko, Hoher Atlas, Köbele Nr. 32 u. 34.
Juncus inflexus L.	Marokko, Mittlerer Atlas, Köbele Nr. 35.
Juncus maritimus L.	Marokko, Antiatlas, Köbele Nr. 28.
Juncus maritimus L.	Marokko, Hoher Atlas, Köbele Nr. 33.
Juncus punctorius L. fil.	Marokko, Mittlerer Atlas, Köbele Nr. 36.
Juncus tenuis Willd.	Deutschland, Bayern, Landkr. FFB, Köbele Nr. 21 u. 39.
Juncus triglumis L.	Deutschland, Bayern, Allgäuer Alpen, E. Dörr s. n., 21.8.1970.
Juncus triglumis L.	Deutschland, Bayern, Blauberge, W. Lippert & J. Sellmair s. n., 8.9.1976
Luzula campestris (L.) DC.	Deutschland, Bayern, Landkr. STA, Köbele Nr. 15.
Luzula campestris (L.) DC.	Deutschland, Sachsen-Anhalt, Harz, Köbele Nr. 25.
Luzula campestris (L.) DC.	Italien, Trentino, Köbele Nr. 27.
Luzula forsteri (SM.)DC.	kultiviert im Bot. Garten München, Köbele Nr. 41
Luzula glabrata (Hoppe) Desv.	Deutschland, Bayern, Landkr. BGL, Köbele Nr. 26.
Luzula luzuloides (Lamk.) Dandy & Wilmott	Deutschland, Bayern, Landkr. FFB, Köbele Nr. 1, 2, 9 u. 12.
Luzula multiflora (Ehrh.)Ley.	Deutschland, Bayern, Landkr. FFB, Köbele Nr. 8.
Luzula pilosa (L.) Willd.	Deutschland, Bayern, Landkr. FFB, Köbele Nr. 3, 4, 7 u. 17.
Luzula pilosa (L.) Willd.	Deutschland, Bayern, Landkr. STA, Köbele Nr.16.
Marsippospermum grandiflorum J. D. Hooker	Chile, Prov. Nuble, E. Werdermann Nr. 302, März 1927.
Oxychloe andina Phil.	Chile, Prov. Atacama, E. Werdermann Nr. 937, Jan. 1926.
Patosia clandestina (Phil.) Buch.	Chile, Prov. Malleco, H. Merxmüller s. n., 27.12.1968.
Prionium serratum L. fil.	Südafrika, Cape Province, P. Goldblatt Nr. 3277, 3.11.1974.
Rostkovia magellanica (Lamk.) J. D. Hooker	South Georgia Islands, Vill Nr. 26, 8.1.1983.

3. Ergebnisse

3.1. Allgemeines zum Bau der Infloreszenzen

Bei den reich verzweigten Arten von *Juncus* und *Luzula* nimmt, ebenso wie bei *Prionium*, der Verzweigungsgrad der Paracladien von proximal nach distal kontinuierlich ab. Die Tragblätter der unteren Paracladien sind noch laubblattartig (frondos) gestaltet, zur Infloreszenzspitze hin werden sie rasch kleiner und erreichen schließlich brakteose Gestalt. Jedes Paracladium trägt basal ein meist deutlich zweikieliges, adossiertes Vorblatt. Das Epipodium ist bei *Juncus* und *Luzula* meist deutlich gestreckt, wodurch die Abstammungsachse übergipfelt wird (Abb. 1c). In der Gattung *Prionium* fehlt die Übergipfelung. Bei stärkeren Paracladien sind zwischen das Vorblatt und die unter den Blüten stehenden Brakteen noch weitere Blätter eingefügt. Wie an der Hauptachse sind diese Blätter proximal noch frondos und werden distal brakteos. Aus den Achseln dieser Blätter erfolgt weitere Verzweigung. Nur bei wenigen Arten entspringt auch aus der Vorblattachsel ein Bereicherungstrieb.

Die Ährchen des Subgenus *Juncus* sind nach einem einheitlichen Prinzip gebaut. Jede Blüte steht in der Achsel eines Tragblattes (Braktee). Auf das letzte fertile Tragblatt folgen entweder mehrere Brakteen, in deren Achseln nur verkümmerte und distal schließlich überhaupt keine Blüten stehen, oder nur eine einzige sterile Braktee ohne Spur einer Blüte. Die Zahl der Blüten pro Ährchen nimmt an Paracladien steigender Ordnung kontinuierlich ab. Die letzten Verzweigungen reichblütiger Infloreszenzen entwickeln oft nur noch Floreszenzen mit drei oder zwei Blüten. Immer folgt aber der obersten Blüte noch mindestens eine sterile Braktee. Im Extremfall wird die Floreszenz auf eine einzige Blüte reduziert. Dies wird am Beispiel von *Juncus maritimus* in Abb. 2 demonstriert. Das einblütige Ährchen ist nicht von den mit zwei Brakteen umhüllten Blüten des Subgenus *Poiophylli* oder der Gattung *Luzula* zu unter-

scheiden. Schon diese Beobachtung führte uns zu der Vermutung, dass in der Familie die mit zwei Brakteen umgebenen Einzelblüten als einblütige Ährchen zu interpretieren sind. In den Verzweigungsschemata ist diese Interpretation bereits berücksichtigt (s. Abb. 1c). Zusätzliche Argumente werden weiter unten in der Diskussion vorgestellt.

Unter Zugrundelegung dieser Arbeitshypothese können die Gattungen mit reichblütigen Infloreszenzen (*Juncus, Luzula, Prionium*) in zwei Hauptgruppen zusammengefasst werden (Abb. 3). Infloreszenzen der Hauptgruppe 1 besitzen mehrblütige Ährchen, diejenigen der Hauptgruppe 2 nur einblütige Ährchen. Subtypen sind in beiden Fällen danach zu unterscheiden, ob zumindest kräftige Exemplare eine Verzweigung aus der Achsel des adossierten Vorblattes hervorbringen (Gruppe 1a bzw. 2a), oder ob die Vorblattachsel immer steril bleibt (Gruppe 1b bzw. 2b). Wenn ein Paracladium aus der Achsel eines Vorblattes gebildet wird, bleibt es stets deutlich schwächer als die aufwärts folgenden. In der Hauptgruppe 2 tritt zusätzlich noch eine dritte Variante auf, bei der einblütige Ährchen zu dichten Ähren 2. Ordnung zusammentreten (Gruppe 2c, s. Tab. 3).

Tabelle 3: Die Zuordnung der im Text behandelten Juncaceen-Taxa zu den beschriebenen Infloreszenzformen.
Table 3:Assignment of the taxa dealt with in the text to the inflorescence types.

Hauptgruppe 1 vielblütige Ährchen		
Gruppe 1a mit Verzweigung aus der Vorblatt-Achsel	Gruppe 1b ohne Verzweigung aus der Vorblatt-Achsel	
Prionium *P. serratum*		
Juncus subgen. *Juncus*		
sect. *Juncus* *J. maritimus* sect. *Caespitosi* *J. capitatus*	sect. *Graminei* *J. capensis* sect. *Stygiopsis* *J. castaneus* *J. triglumis* sect. *Ozophyllum* *J. acutiflorus* *J. articulatus* *J. punctorius*	
Hauptgruppe 2 einblütige Ährchen		
Gruppe 2a mit Verzweigung aus der Vorblatt-Achsel	Gruppe 2b ohne Verzweigung aus der Vorblatt-Achsel	Gruppe 2c Floreszenzen 2. Ordnung
Juncus subgen. *Poiophylli*		
sect. *Tenageia* *J. bufonius* sect. *Juncotypus* *J. conglomeratus* *J. inflexus*	sect. *Steirochloa* *J. tenuis*	
	Luzula sect. *Anthelaea* *L. glabrata* *L. luzuloides* *Luzula* sect. *Pterodes* *L. forsteri* *L. pilosa*	*Luzula* sect. *Gymnodes* *L. campestris* *L. multiflora*

3.2. Infloreszenzen mit mehrblütigen Ährchen (Hauptgruppe 1)

Durch Blütenstände dieses Typs sind die Gattung *Prionium* sowie *Juncus* subgenus *Juncus* charakterisiert.

Gruppe 1a. Die Blütenstände sind dadurch gekennzeichnet, dass die Paracladien auch aus der Achsel von Vorblättern Seitenäste entwickeln können. Dieses Verhalten findet sich besonders an den proximalen Paracladien bei Arten mit reich verzweigten Infloreszenzen. Als Beispiel ist der Blütenstand von *Juncus maritimus* (Sektion *Juncus*) wiedergegeben (Abb. 4). Bei Arten mit nur wenig verzweigten Blütenständen der Sektion *Caespitosi* wurden Vorblatt-Achselsprosse nur vereinzelt festgestellt. Sie treten fakultativ bei besonders kräftigen Individuen an einzelnen Paracladien auf. Der annuelle *Juncus capitatus* besitzt stets nur ein einziges Paracladium dicht unterhalb der Hauptfloreszenz (Abb. 5a, b). An kräftigen Individuen kann aus dessen Vorblatt-Achsel ein Paracladium 2. Ordnung hervorgehen (Abb. 5c, d). Dies wurde auch schon von BUCHENAU (1865) und von v. LAMPE (1996) beschrieben. Ein insgesamt vermutlich ursprüngliches Verhalten zeigt die Gattung *Prionium*. Die Hauptachse der Infloreszenz und die stärkeren Paracladien haben gestreckte Internodien und bleiben dominant gegenüber allen ihren Seitenachsen. Die für *Juncus*- und *Luzula*-Arten so typische Übergipfelung fehlt hier noch vollkommen. Die Hemmung der Seitenachsen höherer Ordnung führt dazu, dass deren Floreszenzen zu dichten Knäueln zusammengedrängt werden (Abb. 5e, f).

Gruppe 1b. Bei den hierher gehörenden Blütenständen wurden selbst bei reichlicher Verzweigung keine Seitenachsen in der Achsel von Vorblättern gefunden. Dieses Verhalten trifft in der Gattung *Juncus* auf die untersuchten Arten der Sektionen *Graminei*, *Ozophyllum* und *Stygiopsis* zu. Nicht nur im Bau der Blütenstände, sondern auch bei den vegetativen Merkmalen sind die Grenzen zwischen diesen drei Sektionen fließend. Die Abgrenzung gegeneinander ist schwierig (vgl. KIRSCHNER et al. 1999). In Abb. 6a ist als Beispiel ein für die ganze Gruppe typischer Blütenstand von *Juncus articulatus* (sect. *Ozophyllum*) im schematischen Aufriss wiedergegeben. Durch eine oft nur geringe Neigung zur Verzweigung zeichnen sich die in Mitteleuropa heimischen Vertreter der Sektion *Stygiopsis* aus (Abb. 6b). Im Extremfall unterbleibt die Bildung von Paracladien vollkommen, so dass der gesamte Blütenstand auf die Hauptfloreszenz beschränkt ist. Ein bekanntes Beispiel hierfür ist der alpine *Juncus triglumis* (sect. *Stygiopsis*). Bei dieser Art fällt auf, dass hier, im Gegensatz zu den meisten Arten der Gattung, die Blüten häufig deutlich gestielt sind (Abb. 6c).

3.3. Infloreszenzen mit einblütigen Ährchen (Hauptgruppe 2)

Einblütige Ährchen sind kennzeichnend für die Gattung *Luzula* sowie für *Juncus* subgenus *Poiophylli*. Außerdem gehören hierher alle fünf südhemisphärischen Gattungen der Juncaceae s.str. Bei diesen tritt allerdings die Besonderheit auf, dass die gesamte Infloreszenz auf ein einziges einblütiges Ährchen reduziert ist. Deshalb sollen diese Gattungen gesondert besprochen werden (s. u.).

Gruppe 2a. Typische Beispiele für diesen Infloreszenztyp finden sich in der Sektion *Juncotypus*, zu der die weit verbreiteten Arten *Juncus effusus*, *J. inflexus* und *J. conglomeratus* gehören. Sie sind durch reichblütige Infloreszenzen gekennzeichnet, bei denen Seitenzweige auch aus der Achsel der Vorblätter proximaler Paracladien gebildet werden (Abb. 6d, 7). Erst an distalen Paracladien bzw. an Paracladien höherer Verzweigungsordnung bleiben die Vorblätter steril. Außer in der Sektion *Juncotypus* wurde dieses Verzweigungsverhalten nur noch bei der aus annuellen Arten bestehenden Sektion *Tenageia* beobachtet. So sind z.B. bei *Juncus bufonius* an nicht zu schwachen Exemplaren regelmäßig Vorblatt-Achselsprosse zu beobachten (Abb. 8). Dies ist eine interessante Parallele zu der ebenfalls aus annuellen Arten bestehenden Sektion *Caespitosi* (Subgenus *Juncus*), bei der auf der Basis der Infloreszenz-Gruppe 1a ebenfalls die Vorblattachseln fertil sein können (vgl. Abb. 5c, d). Hier bietet sich die Spekulation an, dass Annuelle den Nachteil ihrer kurzen Lebensdauer durch Aus-

schöpfung aller Verzweigungsmöglichkeiten und damit maximaler Blüten- und Samenproduktion ausgleichen.

Gruppe 2b. Unter den *Juncus*-Arten mit einblütigen Ährchen wurden Infloreszenzen mit fehlender Verzweigung aus den Vorblattachseln in unserem Material nur bei *J. tenuis* (Sect. *Steirochloa*) gefunden (Abb. 9a). Für die Gattung *Luzula* scheint dieses Merkmal dagegen konstitutiv zu sein. Selbst sehr reich verzweigte Infloreszenzen, wie die von *Luzula glabrata* (Sektion *Anthelaea*) zeigten niemals eine Verzweigung aus der Achsel von Vorblättern (Abb. 9b). In der Sektion *Pterodes* ist der Verzweigungsgrad geringer. Da die Epipodien der Paracladien sich erheblich strecken, wirken die Blütenstände sehr locker (Abb. 10a). Die Vorblattachseln bleiben aber auch hier stets steril.

Gruppe 2c. In der *Luzula*-Sektion *Gymnodes* weisen die Blütenstände einen von den übrigen Vertretern der Gattung abweichenden, offenbar stark abgeleiteten Bau auf. Die Paracladien sind in zwei scharf voneinander getrennte Typen geschieden: Im distalen Bereich der Synfloreszenz stehen Kurzparacladien, die jeweils nur ein Vorblatt und das einblütige Ährchen besitzen. Insbesondere an den distalen Gliedern fällt häufiger die obere, sterile Braktee des Ährchens aus. Die Kurzparacladien stehen dicht gedrängt und bilden dadurch ein Ährchen bzw. ein Köpfchen 2. Ordnung. Proximal folgen Langparacladien, die das Verhalten des distalen Abschnitts der Hauptachse wiederholen. Ihr Vorblatt ist jeweils nahe der Basis inseriert. Auf das verlängerte Epipodium folgen zahlreiche brakteose Tragblätter, in deren Achseln Kurzparacladien nach dem Muster der Hauptachse stehen (vgl. Abb. 3, 10d). Als weitere Besonderheit ist festzuhalten, dass das terminale Ährchen der Hauptachse und der Langparacladien häufig nicht mehr ausgebildet wird. Stattdessen findet man im Distalbereich der Achse nur noch einige sterile Brakteen (Abb. 10c, d). Es handelt sich hier um eine fakultative Trunkation der Synfloreszenz, die oft auch auf die Langparacladien übergreift.

3.4. Die Infloreszenzen der südhemisphärischen Gattungen

Rostkovia und *Marsippospermum*. Die beiden circum-antarktisch verbreiteten Gattungen sind einander habituell sehr ähnlich. Sie tragen eine einblütige Infloreszenz, die durch ein schaftartiges Internodium weit emporgehoben wird (Abb. 11a). Die Blüte wird von zwei Brakteen begleitet. Bei *Rostkovia* ist die untere Braktee laubblattartig gestaltet und überragt die Blüte deutlich (Abb. 11b). *Marsippospermum* fällt durch den Besitz der größten Blüten der Familie auf, trägt unter der Blüte aber nur eine oder zwei winzige Brakteen (Abb. 11c). Die Infloreszenz ist in beiden Fällen als einblütiges Ährchen zu interpretieren. Die gesamte Synfloreszenz ist auf die einblütige Hauptfloreszenz reduziert, Paracladien werden nicht mehr angelegt.

Distichia, Oxychloe und *Patosia*. Die drei Gattungen sind als Polsterpflanzen auf hochandine Lebensräume beschränkt. Bis auf eine *Oxychloe*-Art sind sie alle diözisch. Die einblütigen Infloreszenzen aller drei Gattungen entspringen jeweils der Achsel eines Laubblattes im distalen Bereich des vegetativen Sprosses. Bei *Distichia* und *Patosia* wird die männliche Infloreszenz durch ein lang gestrecktes Epipodium deutlich über das Polster emporgehoben (Abb. 11f). Die weibliche Infloreszenz bleibt dagegen in der Blattachsel verborgen, es werden nur die Narben im freien Luftraum exponiert. Bei *Oxychloe* sind die Blüten beiderlei Geschlechts etwa gleich lang gestielt (Abb. 11d). Direkt unterhalb der Blüte stehen in der Regel zwei Brakteen, *Patosia* besitzt aber nur noch eine Braktee. Für *Distichia* gibt VIERHAPPER (1930) 1–2 Brakteen an, BALSLEV (1996) spricht von 2–4 Brakteen. In dem von uns untersuchten Material fanden sich stets zwei Brakteen. Das Gesamtbild deutet auch in diesen drei Gattungen wieder darauf hin, dass es sich bei den Infloreszenzen um einblütige Ährchen handelt. Die Infloreszenzen aller drei Gattungen sind jeweils als Paracladium mit einer einblütigen Cofloreszenz aufzufassen. Die gesamte Synfloreszenz ist auf ein einziges, einblütiges Paracladium reduziert, die Hauptachse proliferiert (Abb. 11e, g).

4. Diskussion

4.1. Das einblütige Ährchen

Entscheidend für das Verständnis der Juncaceen-Infloreszenzen ist die Deutung der von zwei Brakteen begleiteten Einzelblüte. Die vergleichende Analyse hat uns zu der in sich widerspruchsfreien Auffassung geführt, dass diese Blüte, zusammen mit den zwei Brakteen, ein einblütiges Ährchen repräsentiert. Obwohl der entwicklungsgeschichtliche Nachweis für die axilläre Anlegung der pseudoterminalen Blüte noch aussteht, sprechen die morphologischen Beobachtungen deutlich für diese Interpretation.

Ein erstes Argument gegen die Terminalität der Einzelblüte liefern Ährchen von *Luzula* Sektion *Gymnodes*, bei denen die obere Braktee ausgefallen ist. Der Anschluss der Blattspirale des äußeren Perigonkreises einer Terminalblüte müsste sich stets nach dem zuletzt unter der Blüte angelegten Blatt richten. Tatsächlich zeigt das Perigon aber eine festliegende Position zur unteren Braktee, egal, ob die obere angelegt wird oder nicht. Abb. 12a zeigt diagrammatisch den Normalfall mit zwei Brakteen. Es fällt auf, dass die obere Braktee etwas aus der Mediane verschoben ist. Von den Organen des äußeren Perigonkreises liegt das innerste direkt vor der unteren Braktee. Das ist die gleiche Position wie bei den Achselblüten von *Juncus* subgen. *Juncus*. Wenn die obere Braktee ausfällt, ändert sich an dieser Stellung nichts (Abb. 12b). Die Blüte ist mit der unteren Braktee in genau der Weise korreliert, wie es für eine Achselblüte zu fordern ist.

In diesem Zusammenhang ist noch einmal an den in Abb. 2c dargestellten Fall zu erinnern, bei dem ein Ährchen von *Juncus maritimus* (*Juncus* subgen. *Juncus*) bis auf eine Blüte verarmt ist. Es kann kein Zweifel daran bestehen, dass es sich hierbei um ein einblütiges Ährchen handelt. Die einzige verbliebene Blüte ist in eine pseudoterminale Position gedrängt. Aus dem Vergleich mit den zunehmend verarmenden Ährchen des Gesamtblütenstandes ist kein anderer Schluss zu ziehen, als dass die Blüte der Achsel der unteren Braktee entspringt, und dass ihr aufwärts, als letztes Organ der terminal offenen Achse, eine sterile Braktee folgt. Dass die Einzelblüten der übrigen Juncaceen einschließlich der Arten von *Juncus* subgen. *Poiophylli* tatsächlich einem Ährchen homolog sind, wird durch einen weiteren Befund gestützt: Bei der Analyse eines Blütenstandes von *Juncus conglomeratus* fand sich ein Ährchen, das statt der üblichen Einzelblüte zwei Blüten entwickelt hatte (Abb. 7, 12c). Auf die zweite (distale) Blüte folgte auch hier wieder eine sterile Braktee. Dieses Ährchen unterscheidet sich nicht von einem auf zwei Blüten verarmten Ährchen des *Juncus maritimus* (vgl. Abb. 12c und d).

4.2. Zur Typologie und Phylogenie der Juncaceen-Synfloreszenz

Wenn die von zwei Brakteen umfassten Einzelblüten der Juncaceen je einem Ährchen entsprechen, gehören alle Blütenstände der Familie dem Typus der polytelen Synfloreszenz an. Die Floreszenzen sind Ährchen bzw. Köpfchen, die bis zur Einblütigkeit reduziert sein können. Die Anordnung der ein- oder mehrblütigen Floreszenzen im Gesamtverzweigungssystem erfolgt analog der Anordnung von terminalen Einzelblüten in monotelen Systemen. Dadurch ergibt sich in den reicher verzweigten Blütenständen eine täuschende Ähnlichkeit zu bestimmten monotelen Synfloreszenzen. Der an eine Kegelrispe erinnernde Blütenstand von *Prionium* hat tatsächlich ein der Rispe (Panicula) entsprechendes Achsensystem, trägt aber am Ende jeder Achse statt der für die Rispe zu fordernden Endblüte eine offene Floreszenz. Bei den reicher verzweigten *Juncus*-Arten sowie bei *Luzula* sect. *Anthelaea* und sect. *Pterodes* sind die Hauptachse und die Achsen der großen Paracladien so stark gestaucht, dass sie von ihren jeweiligen Seitenachsen deutlich übergipfelt werden. Auf diese Weise entsteht ein Achsensystem, das mit dem einer Trichterrispe bzw. Spirre vollkommen identisch ist. Wiederum unterscheidet sich der Blütenstand aber von der Trichterrispe (Anthela) dadurch, dass er am Ende jeder Achse statt der Terminalblüte eine offene Floreszenz trägt. TROLL (1968, S. 94) hat für diese polytelen Blütenstände, die ein Analogon zu entsprechenden Monotelen

darstellen, die Begriffe Paniculodium bzw. Anthelodium vorgeschlagen. Mit diesen Begriffen sind die Blütenstände von *Prionium* bzw. von *Juncus* und *Luzula* treffend zu bezeichnen.

Erst auf der Basis des Anthelodiums ist auch ein spezieller Paracladientyp, das Drepanium (die sogenannte Sichel), zu verstehen. Es handelt sich hierbei um äußerst spezialisierte, sympodial verzweigte Paracladien mit einer größeren Anzahl wiederholter Übergipfelungen. Voraussetzung für die Entstehung eines Drepaniums ist die fortlaufende Bildung besonders gestalteter, stets gleichbleibender Sympodialglieder. Jedes dieser Glieder muss ein adossiertes Vorblatt, ein mit einem Divergenzwinkel von 180° folgendes weiteres Blatt und das distale Ährchen besitzen. Das zwischen dem Vorblatt und dem Ährchen stehende Blatt fällt somit immer abaxial in die Medianebene und steht genau über dem Tragblatt des jeweiligen Sympodialgliedes. Nur aus der Achsel des zwischen dem Vorblatt und dem Ährchen stehenden Blattes erfolgt die weitere Verzweigung (s. z.B. Pc2 in Abb. 8). Diese fixierte Blatt- und Verzweigungsfolge konnte in unserem Material bisher nur bei Vertretern mit einblütigen Ährchen, und zwar in den Sektionen *Tenageia* und *Steirochloa* gefunden werden (vgl. Abb. 8 und 9a). Das Drepanium kennzeichnet keinesfalls generell die Gattung *Juncus* und findet sich offenbar überhaupt nicht in der Gattung *Luzula*.

Überlegungen zu den Beziehungen zwischen den Blütenstandstypen der Juncaceae s.l. sind schematisch in Abb. 13 dargestellt. Am ursprünglichsten dürften die Infloreszenzen von *Prionium* mit mehrblütigen Ährchen, reicherer Verzweigung und gestreckten Internodien sein (Abb. 13a). Den prinzipiell gleichen Bau haben auch noch die Infloreszenzen von *Juncus* subgen. *Juncus*, nur wird das äußere Erscheinungsbild durch die Achsenstauchung und die sich daraus ergebenden Übergipfelungen modifiziert. Von hier aus sind mehrere Wege der Verarmung und/oder der Spezialisierung zu erkennen. Durch Wegfall der Paracladien resultiert eine auf die Hauptfloreszenz reduzierte Synfloreszenz, wie sie etwa von *J. triglumis* repräsentiert wird (Abb. 13d). Bei *Juncus* subgen. *Poiophylli* und allen übrigen Gattungen sind die Floreszenzen einblütig geworden. Mehr oder weniger, zum Teil aber sehr reich verzweigt sind die Infloreszenzen von *Juncus* subgen. *Poiophylli* sowie von *Luzula* sect. *Anthelaea* und *Pterodes* (Abb. 13b). Bei *Luzula* sect. *Gymnodes* sind die blühenden Seitenäste in distale Kurzparacladien und proximale Langparacladien differenziert (Abb. 13c). Dazu kommt eine deutliche Tendenz zur Verrumpfung (Trunkation). Dieses Muster findet sich in vielen Familien mit polytelem Synfloreszenzbau (vgl. WEBERLING 1981). Durch Verarmung bis zur Einblütigkeit der gesamten Synfloreszenz sind die in kühlen Klimaten der Südhemisphäre beheimateten Gattungen gekennzeichnet. *Marsippospermum* und *Rostkovia* besitzen nur noch die einblütige Hauptfloreszenz, während die Paracladienbildung völlig unterdrückt wird (Abb. 13e). Durch das Merkmal der Prolifikation sind die Gattungen *Distichia*, *Oxychloe* und *Patosia* gekennzeichnet. Die Blütenbildung ist dadurch nur noch an Paracladien möglich. Jeder blühende Spross dieser Gattungen besitzt nur noch ein einziges, einblütiges Kurzparacladium (Abb. 13f).

Mit diesen Vorstellungen werden die Annahmen von BUCHENAU (1890) vom Kopf auf die Füße gestellt (vgl. Abb. 1a, b). Bei der Gegenüberstellung von *Juncus* subgen. *Poiophylli* (Abb. 1a) und *Juncus* subgen. *Juncus* (Abb. 1b) muß der Pfeil von rechts nach links weisen. Außerdem ist nicht das einblütige Paracladium im Subgenus *Poiophylli* einer axillären Einzelblüte des Ährchens von Subgenus *Juncus* homolog. Vielmehr entspricht das dreiblütige Ährchen in Abb. 1b dem distalen, einblütigen Ährchen in Abb. 1a. Um ganz genau zu sein: Die Blüte des terminalen Ährchens in Abb. 1a entspricht der untersten Blüte des Ährchens in Abb. 1b.

4.3. Vergleich mit dem Infloreszenzbau der Cyperaceae

Als sehr eng verwandt mit den Juncaceae s.l. gelten die Cyperaceae und die Thurniaceae. Zu diesem Ergebnis führen sowohl intensive Analysen aller klassischen Merkmale (DAHLGREN & RASMUSSEN 1983, DAHLGREN et al. 1985, SIMPSON 1995) als auch jüngste molekulare

Analysen (DUVALL et al. 1993, LINDER & KELLOGG 1995, CHASE et al. 2000, MUASYA et al. 2000). Eine Analyse der kugelförmig-kompakten Blütenstände von *Thurnia* steht noch aus. Infloreszenzen der Cyperaceae sind dagegen schon häufig untersucht worden. Aus neuerer Zeit sind die Arbeiten von BROWNING & GORDON-GRAY (1999), EITEN (1976), KUKKONEN (1984, 1986, 1994), TIMONEN (1998), VEGETTI (1992, 1994) sowie VEGETTI & TIVANO (1991) zu nennen. Nachdem vielfach Ährchen mit echten Terminalblüten beschrieben worden sind (z.B. KOYAMA 1971), ist inzwischen für die meisten derartigen Fälle Pseudoterminalität zumindest sehr wahrscheinlich gemacht worden. Für die ganze Familie darf wohl polyteler Bau der Infloreszenzen angenommen werden. Es bleiben nur ganz wenige unklare Fälle, wie z. B. *Scirpodendron* und die sehr aberrante Gattung *Chrysitrix*, die eine scheinbar terminale Blüte besitzen, bei denen aber aus vergleichenden Gründen ebenfalls Pseudoterminalität anzunehmen ist (GOETGHEBEUR 1998).

Die elementare Baueinheit der Synfloreszenz der Cyperaceen ist das Ährchen. Wie bei den Juncaceen ist es im ursprünglichen Fall mehrblütig. Es trägt manchmal basal, häufig aber distal sterile Spelzen. Weit verbreitet ist die Tendenz zur Reduktion auf die Einblütigkeit (EITEN 1976, GOETGHEBEUR 1998). Besonders in diesen Fällen nimmt die einzig verbleibende Blüte eine pseudoterminale Position ein, distal der einzigen fertilen Braktee steht auch hier noch eine sterile Braktee (EITEN 1976, vgl. Abb. 12e, f). Ähnlich wie bei *Luzula* sect. *Gymnodes* treten die einblütigen Ährchen oft zu Ährchen 2. Ordnung zusammen (z.B. die weiblichen „Ähren" von *Carex*). Eine weitere Parallele zu den Juncaceae besteht in der Organisation des Gesamtblütenstandes. Er ist im ursprünglichen Fall nach dem Muster einer elongaten Rispe gebaut und stellt ein Paniculodium dar (z. B. *Rhynchospora*, s. RAYNAL 1971). Mehrfach ist daraus das polytele Analogon der Trichterrispe hervorgegangen. Die Infloreszenzen von *Scirpus*, *Cyperus* oder *Bolboschoenus* liefern dafür anschauliche Beispiele. Auf diese Infloreszenzen wenden z.B. RAYNAL (1971) und GOETGHEBEUR (1998) noch den Terminus „anthèle" bzw. „anthela" an, während KUKKONEN (1994) und BROWNING & GORDON-GRAY (1999) sie zutreffend als Anthelodium bezeichnen.

Diese kurze Übersicht macht deutlich, dass die Infloreszenzen der Juncaceae und der Cyperaceae in vielen Merkmalen übereinstimmen. Die nahe Verwandtschaft beider Familien kann jetzt auch mit dem Merkmalsbereich der Blütenstände gut belegt werden.

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Christian P. KÖBELE & Prof. Dr. Hans-Jürgen TILLICH, Institut für Systematische Botanik der Ludwig-Maximilians-Universität München, Menzinger Strasse 67, D-80638 München. Deutschland.

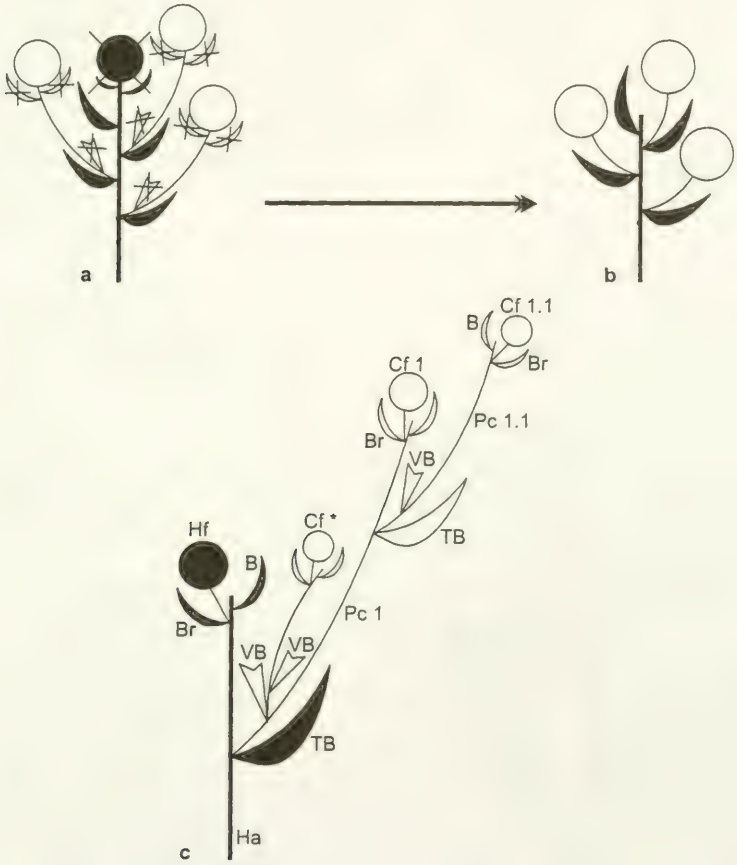

Abb. 1: a, b: Hypothetischer Übergang des Infloreszenzbaues von *Juncus* subgen. *Poiophylli* (a) zum subgen. *Juncus* (b) nach BUCHENAU (1890). **c:** *Juncus* subgen. *Poiophylli*. Verzweigungsschema mit Angabe der im folgendenText verwendeten Symbole. B: sterile Braktee; Br: fertile Braktee; Cf*: Cofloreszenz eines Paracladiums aus der Vorblattachsel; Cf 1 bzw. 1.1: Cofloreszenz eines Paracladiums 1. bzw. 2. Ordnung; Ha: Hauptachse; Hf: Hauptfloreszenz; Pc1 bzw. Pc 1.1: Paracladium 1. bzw. 2. Ordnung; TB: Tragblatt; VB: Vorblatt.

Fig. 1: a, b: Hypothetical transformation of the inflorescence type of *Juncus* subgenus *Poiophylli* (a) to that of subgenus *Juncus* (b) after BUCHENAU (1890). **c:** *Juncus* subgenus *Poiophylli*. Branching pattern with indication of symbols used in the following text. B: sterile bract; Br: fertile bract; Cf*: coflorescence of a paracladium originating from the axil of a prophyll; Cf 1. and 1.1: coflorescence of a paracladium of first and second order, respectively; Ha: main axis; Hf: main florescence; Pc 1 and 1.1: paracladium of first and second order, respectively; TB: pherophyll; VB: prophyll.

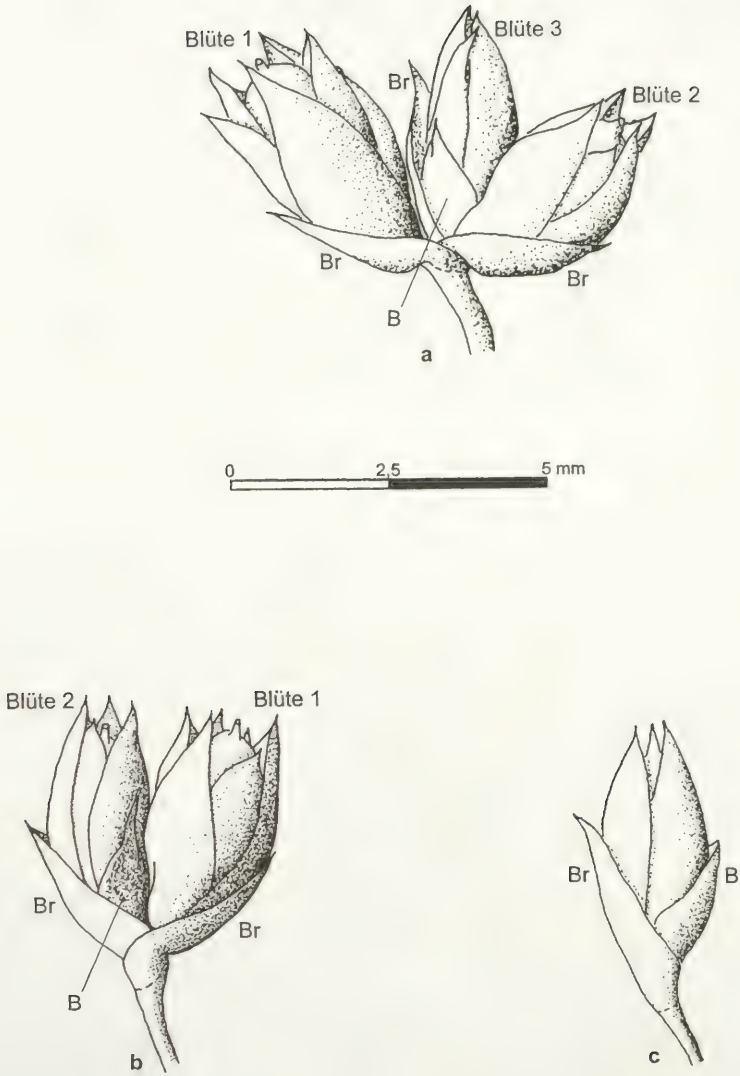

Abb. 2: *Juncus maritimus*. Armblütige Ährchen.
a: dreiblütig; b: zweiblütig; c: einblütig.
Beachte die sterile Braktee (B), die jeweils distal der zuletzt gebildeten Blüte steht!

Fig. 2: *Juncus maritimus*. Few-flowered spikelets.
a: three-flowered; b: two-flowered; c: one-flowered.
Note the sterile bract distal to the uppermost flower of each spikelet!

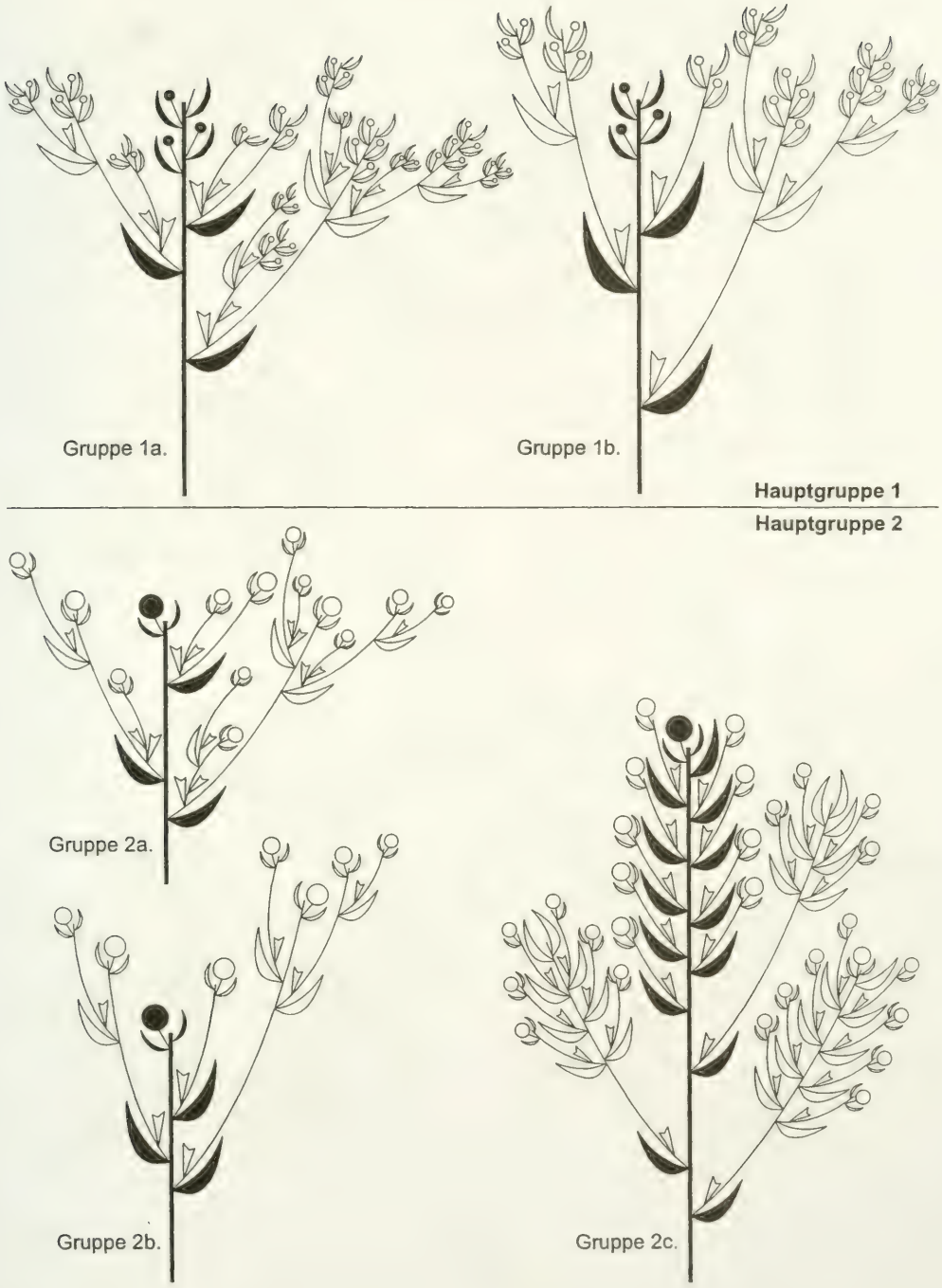

Abb. 3: Schema der Grundtypen des Infloreszenzbaues der Juncaceae s.l.
Oben: Infloreszenzen mit mehrblütigen Ährchen (Hauptgruppe 1);
Unten: Infloreszenzen mit einblütigen Ährchen (Hauptgruppe 2). Nähere Erläuterungen im Text.

Fig. 3: Basic types of inflorescence structure in Juncaceae s.l.
Above: Inflorescences with many-flowered spikelets (main group 1);
Below: Inflorescences with one-flowered spikelets (main group 2). Further explanation in the text.

Abb. 4: *Juncus maritimus*. Aufriss einer Infloreszenz.
Fig. 4: *Juncus maritimus*. Schematic elevation of an inflorescence.

Abb. 5: Infloreszenzen der Gruppe 1a.

a-d: *Juncus capitatus*. a: Typische Infloreszenz; b: Aufriss von Fig. a; c: Infloreszenz mit Verzweigung aus der Achsel des Vorblattes; d: Aufriss von Fig. c.

e, f: *Prionium serratum*. e: Teilinfloreszenz; f: Aufriss von Fig. e.

Fig. 5: Inflorescences of the group 1a.

a-d: *Juncus capitatus*. a: typical inflorescence; c: inflorescence with a branch from the axil of a prophyll; b, d: schematic elevations of figs. a and c. e, f: *Prionium serratum*. e: partial inflorescence; f: schematic elevation of fig. e.

Abb. 6: a-c: Infloreszenzen von *Juncus* sectiones *Ozophyllum* und *Stygiopsis*. a, b: schematischer Aufriss der Infloreszenzen, a: *J. articulatus*; b: *J. castaneus*; c: *J. triglumis*, eine vollständige Infloreszenz, auf der Rückseite der dritten Blüte befindet sich eine sterile Braktee; d: *J. inflexus* (sect. *Juncotypus*), Paracladium mit Verzweigung aus der Vorblattachsel. Dicht unterhalb jedes Ährchens steht ein Tragblatt (Tb°) mit einer rudimentären Blütenanlage. N: Resektionsfläche des Tragblatts von Pc 1.

Fig. 6: a-c: Inflorescences of *Juncus* sectiones *Ozophyllum* and *Stygiopsis*. a, b: schematic elevation of inflorescences, a: *J. articulatus*; b: *J. castaneus*; c: *J. triglumis*, a complete inflorescence, on the back-side of the third flower there is a sterile bract; d: *J. inflexus* (sect. *Juncotypus*), paracladium with a branch from the axil of the prophyll. Closely below each spikelet there is a bract (Tb°) with a rudimentary flower bud in its axil. N: scar of the dissected pherophyll of Pc 1.

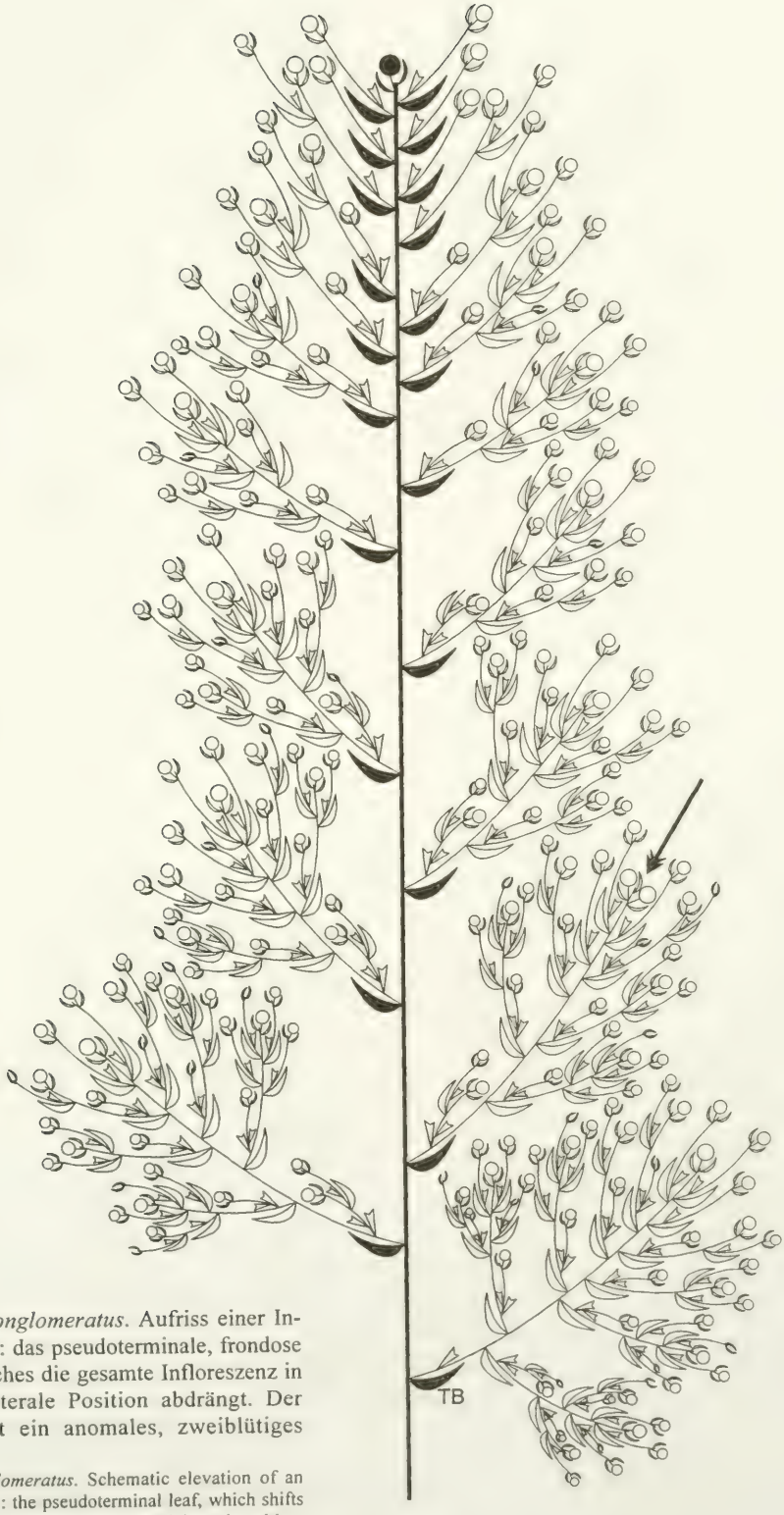

Abb. 7: *Juncus conglomeratus*. Aufriss einer Infloreszenz; TB: das pseudoterminale, frondose Tragblatt, welches die gesamte Infloreszenz in eine pseudolaterale Position abdrängt. Der Pfeil markiert ein anomales, zweiblütiges Ährchen.

Fig. 7: *Juncus conglomeratus*. Schematic elevation of an inflorescence; TB: the pseudoterminal leaf, which shifts the complete inflorescence into a pseudolateral position. The arrow marks an abnormal, two-flowered spikelet.

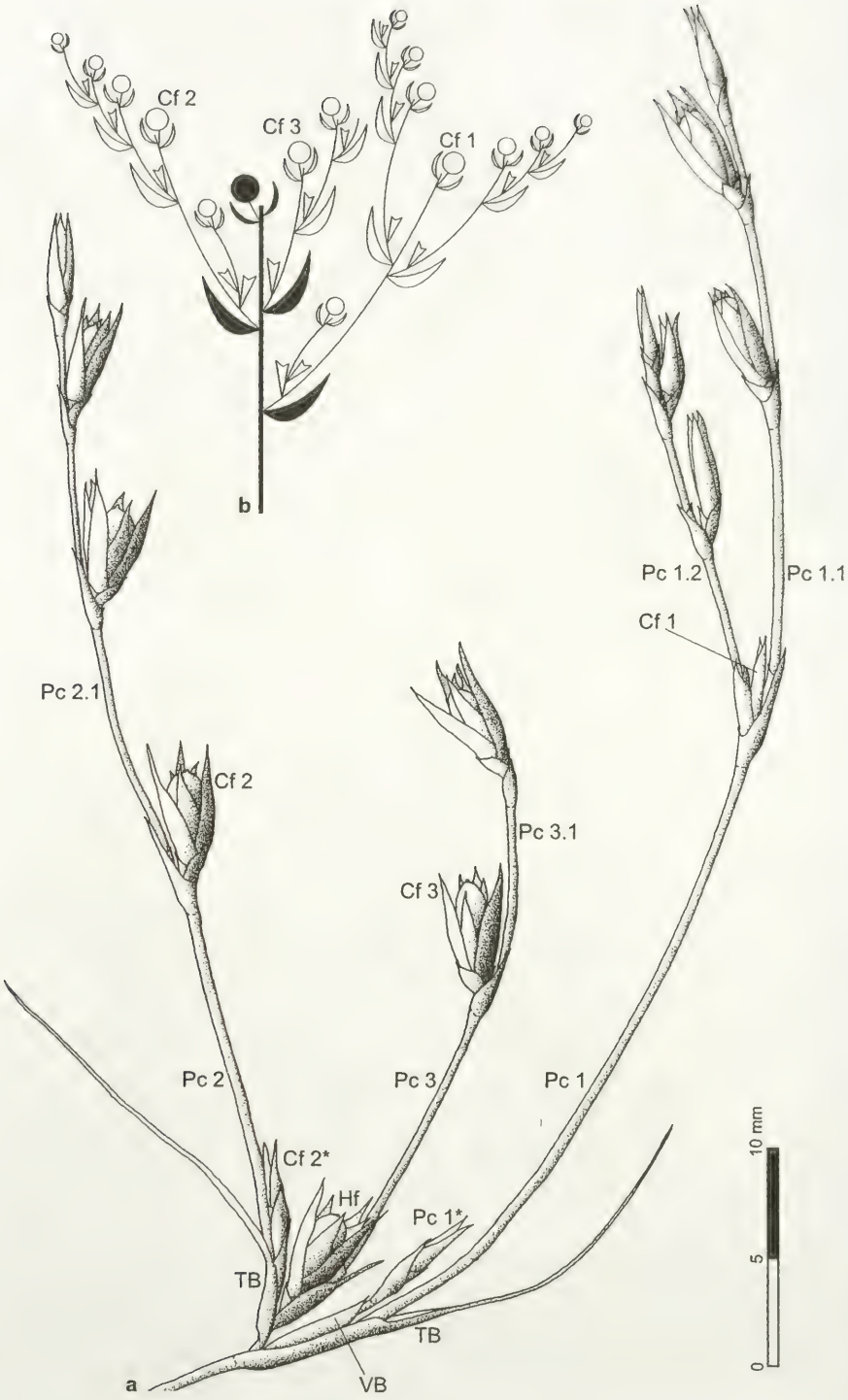

Abb. 8: *Juncus bufonius*. a: distaler Bereich einer Infloreszenz; b: das dazugehörige Aufrissdiagramm.

Fig. 8: *Juncus bufonius*. a: distal region of an inflorescence; b: schematic elevation of the same object.

Abb. 9: Aufrisse von Infloreszenzen der Gruppe 2b. a: *Juncus tenuis*; b: *Luzula glabrata*.

Fig. 9: Schematic elevations of inflorescences representing group 2b. a: *Juncus tenuis*; b: *Luzula glabrata*.

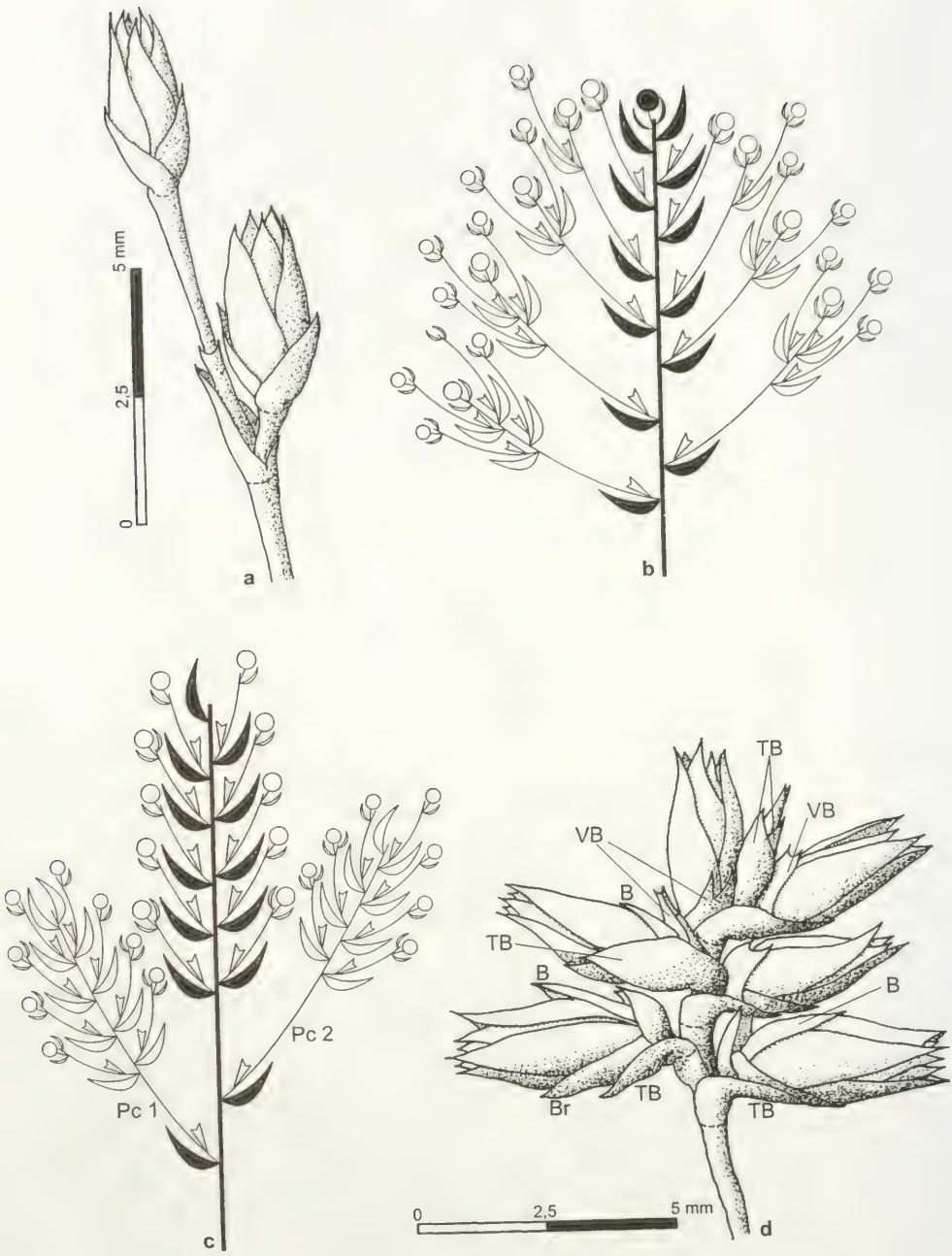

Abb. 10: Infloreszenzbau bei *Luzula*. a, b: sect. *Pterodes*. a: *L. pilosa*, Detail der Verzweigung; b: *L. forsteri*, Aufriss einer Infloreszenz. c, d: sect. *Gymnodes*. c: *L. campestris*, schematischer Aufriss einer Infloreszenz; d: Pc2 im Detail.

Fig. 10: Inflorescence structure in *Luzula*. a, b: sect. *Pterodes*. a: *L. pilosa*, detail of branching; b: *L. forsteri*, schematic elevation of an inflorescence. c, d: sect. *Gymnodes*. c: *L. campestris*, schematic elevation of an inflorescence; d: Pc2 in detail.

Abb 11: Infloreszenzbau südhemisphärischer Juncaceae. a, b: *Rostkovia magellanica*; c: *Marsippospermum grandiflorum*; d, e: *Oxychloe andina*; f, g: *Distichia muscoides*. Nähere Erläuterung im Text.

Fig. 11: Inflorescence structure in south hemispherical Juncaceae. a, b: *Rostkovia magellanica*; c: *Marsippospermum grandiflorum*; d, e: *Oxychloe andina*; f, g: *Distichia muscoides*. Further explanation in the text.

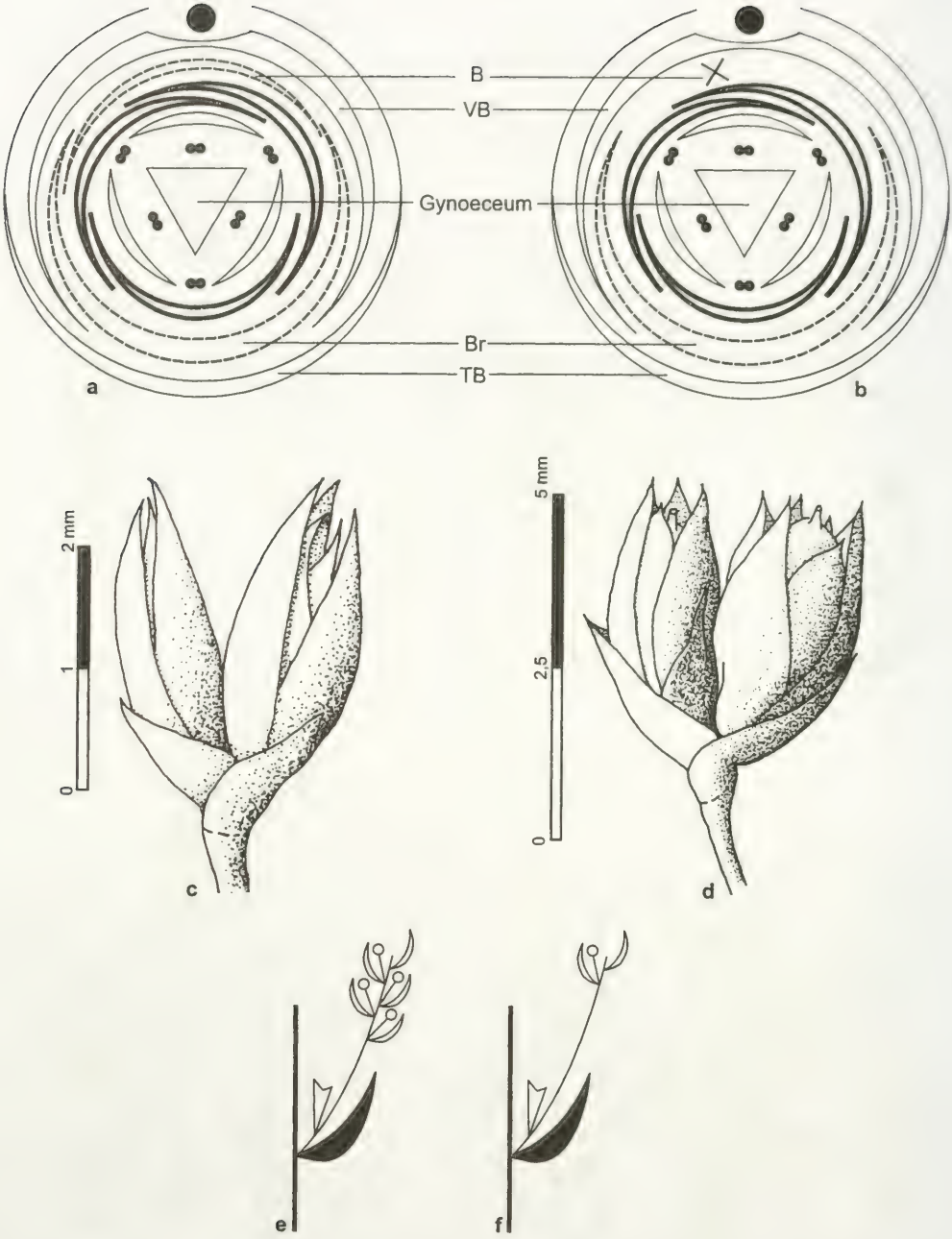

Abb. 12: Ährchenbau bei Juncaceae und Cyperaceae. a, b: *Luzula campestris*, Ährchen-Diagramme. a: Ährchen mit zwei Brakteen; b: obere Braktee ausgefallen. c, d: armblütige Ährchen von *Juncus*. c: ausnahmsweise zweiblütiges Ährchen von *J. conglomeratus*. Die sterile obere Braktee befindet sich auf der vom Betrachter abgewandten Seite. d: Auf zwei Blüten verarmtes Ährchen von *J. maritimus*. e, f: Ährchen von Cyperaceen, schematisch. e: *Eleocharis*; f: *Cyperus* (nach EITEN 1976, S. 83, geändert).

Fig. 12: Spikelets in Juncaceae and Cyperaceae. a, b: *Luzula campestris*, diagrams of spikelets. a: spikelet with two bracts; b: the upper bract is missing; c, d: few-flowered spikelets in *Juncus*. c: unusually two-flowered spikelet of *J. conglomeratus*, the sterile bract is at the back of the spikelet; d: impoverished, two-flowered spikelet of *J. maritimus*. e, f: spikelets of Cyperaceae, schematically. e: *Eleocharis*; f: *Cyperus* (after EITEN 1976, p. 83, modified).

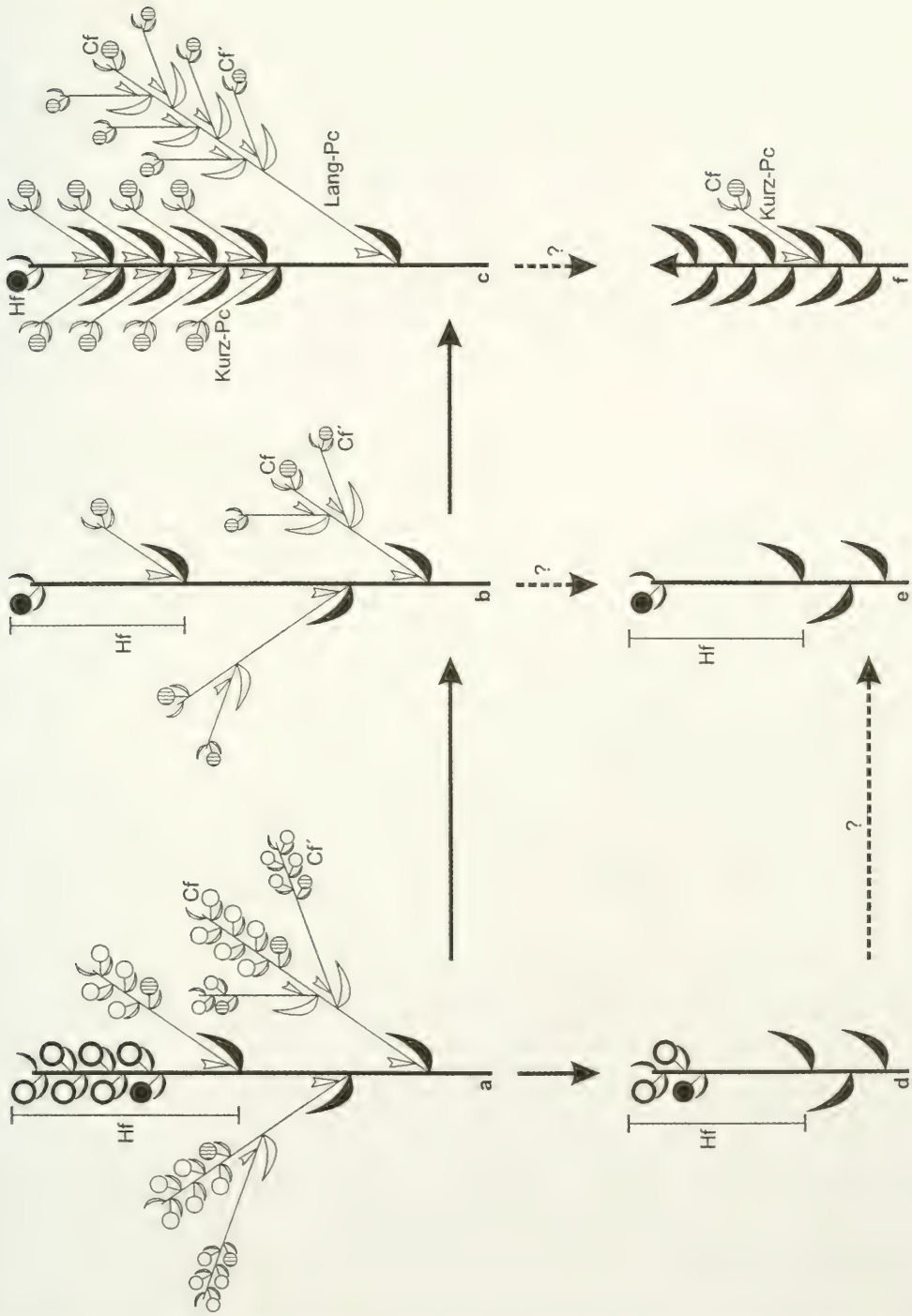

Abb. 13: Vermutete Beziehungen zwischen den Infloreszenz-Typen der Juncaceae. Nähere Erläuterung im Text.

Fig. 13: Supposed relationships between inflorescence types of Juncaceae. Further explanation in the text.

Contributions to the knowledge of the genus *Astragalus* L. (Leguminosae) VII–X[1]

D. PODLECH

Abstract:
PODLECH, D.: Contributions to the knowledge of the genus *Astragalus* L. (Leguminosae) VII–X. – Sendtnera 7: 163–201. 2001. ISSN 0944–0178.

VII. A survey of *Astragalus* L. sect. *Leucocercis*. The section, endemic in Iran with six species, is revised. Synonymy, descriptions, the investigated specimens and a key for the species are given. VIII. New typifications and changes of typification in *Astragalus*-species. 12 wrongly typified species are re-typified. 19 taxa are typified here. IX. Some new species in genus *Astragalus*: 27 new species, one subspecies and one section are described here. They belong to the following sections: Sect. *Caprini*: *A. behbehanensis, A. bozakmanii, A. spitzenbergeri*. Sect. *Cenantrum*: *A. tecti-mundi* subsp. *orientalis*. Sect. *Chlorostachys*: *A. poluninii*, *A. rhododendrophila*. Sect. *Cystium*: *A. owirensis*. Sect. *Dissitiflori*: *A. argentocalyx, A. bingoellensis*, *A. doabensis*, *A. fruticulosus*, *A. lanzhouensis*, *A. montis-karkasii*, *A. pravitzii*, *A. recurvatus*, *A. saadatabadensis*, *A. sata-kandaoensis*, *A. wakhanicus*. Sect. *Hemiphaca*: *A. sherriffii*, *A. tsangpoensis*. Sect. *Incani*: *A. olurensis*, *A. zaraensis*. Sect. *Komaroviella*: *A. damxungensis*. Sect. *Onobrychoidei*: *A. rasmontii*. Sect. *Polycladus*: *A. austrotibetanus*, *A. cobresiiphila*, *A. conaensis*. Sect. *Pseudotapinodes*, sect. nov.: *A. dickorei*. X. New names and combinations are given. Four illegitimate names are changed, two taxa have been raised in rank.

Zusammenfassung:
VII. A survey of *Astragalus* L. sect. *Leucocercis*. Eine Revision von *Astragalus* L. sect. *Leucocercis* wird vorgestellt. Die Sektion ist endemisch im Iran und umfasst sechs Arten. Ausführliche Synonymie, Beschreibung der Arten, Aufzählung der untersuchten Belege und ein Bestimmungsschlüssel werden gegeben. VIII. New typifications and changes of typification in *Astragalus*-species. Neue Typifizierungen und Änderungen früherer Typifizierungen werden vorgestellt. 12 Arten waren bisher falsch typifiziert, 19 Taxa werden hier typifiziert. IX. Some new species in genus *Astragalus*: 27 neue Arten, eine neue Unterart und eine neue Sektion werden beschrieben. Sie gehören zu folgenden Sektionen: Sect. *Caprini*: *A. behbehanensis, A. bozakmanii, A. spitzenbergeri*. Sect. *Cenantrum*: *A. tecti-mundi* subsp. *orientalis*. Sect. *Chlorostachys*: *A. poluninii*, *A. rhododendrophila*. Sect. *Cystium*: *A. owirensis*. Sect. *Dissitiflori*: *A. argentocalyx, A. bingoellensis*, *A. doabensis*, *A. fruticulosus*, *A. lanzhouensis*, *A. montis-karkasii*, *A. pravitzii*, *A. recurvatus*, *A. saada-*

[1] PODLECH, D.: Beiträge zur Kenntnis der Gattung *Astragalus* I. Neue und bemerkenswerte Arten aus Afghanistan. Bot. Jahrb. Syst. 107: 55–73. 1985. – Beiträge zur Kenntnis der Gattung *Astragalus* L. (Leguminosae) II. *Astragalus renzianus* species nova aus dem Iran. Mitt. Bot. Staatss. München 22: 1–3. 1986. – Beiträge zur Kenntnis der Gattung *Astragalus* L. (Leguminosae) III–VI. Sendtnera 1: 267–272. 1993.

tabadensis, *A. sata-kandaoensis*, *A. wakhanicus*. Sect. *Hemiphaca*: *A. sherriffii*, *A. tsangpoensis*. Sect. *Incani*: *A. olurensis*, *A. zaraensis*. Sect. *Komaroviella*: *A. damxungensis*. Sect. *Onobrychoidei*: *A. rasmontii*. Sect. *Polycladus*: *A. austrotibetanus*, *A. cobresiiphila*, *A. conaensis*. Sect. *Pseudotapinodes*, sect. nov.: *A. dickorei*. X. New names and combinations are given. Vier illegitime Namen werden geändert, zwei Sippen werden im Rang verändert.

VII. A survey of *Astragalus* L. sect. *Leucocercis* Bunge.

The species of the small section *Leucocercis* are all endemic in Iran. They have all a characteristic habit and are all close together. It is a section with no closer allies within the genus. The section has been revised twice in recent years, but in both cases important characters especially in the indument structure have not been taken into consideration and several types have not been investigated. Therefore several changes of names and new circumscription of the species are offered here.

Astragalus sect. ***Leucocercis*** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 132. 1868. Lectotype (PODLECH 1990): *A. mucronifolius* Boiss.

Plants low, mostly densely cushion-like spiny shrublets with short growth in one year. Hairs merely white, mostly appressed, symmetrically to strongly asymmetrically medifixed, in part even basifixed. Stipules adnate to the petiole, free from each other. Leaves paripinnate, with thickly leathery, acuminate-cuspidate leaves with prominent nerves. Rhachis rigid, pungent, persistent, of variable length. Racemes with a mostly short peduncle, loosely 3–15-flowered. Bracts short. Bracteoles present, in upper part of the pedicel or at the base of the calyx. Calyx campanulate to shortly tubular, hairy, with slightly to distinctly pungent teeth. Petals glabrous, pink (always ?), deciduous. Standard blade elliptic to suborbicular, slightly retuse at the apex. Wings and keel as long or only slightly shorter than the standard. Staminal tube truncate at the mouth. Legumes sessile, short, unilocular; valves coriaceous, hairy. Seeds 1–8.

Key to the species

Remark: The form of legumes is very characteristic in some species. If they are not available, it is necessary to compare carefully all the characters in the descriptions.

1. Bracts densely hairy; calyx teeth 1.5–2 mm long, often recurved; standard 9–10 mm long; legumes 5–8 mm long, with only one seed *A. curviflorus* Boiss.
– Bracts only ciliate at the margins; calyx teeth longer, not recurved; standard distinctly longer; legumes distinctly longer, with several seeds 2
2. Stems of the current year nearly glabrous; rhachis of the leaves covered with strongly asymmetrically medifixed hairs up to 1.5 mm long; legumes ovoid, 9–15 mm long, 7–11 mm high and wide, rounded ventrally and dorsally; leaflets with a cusp 1.5–3 mm long; peduncles 2–8 cm long *A. ovoideus* Sirj. & Rech.f.
– Stems of the current year densely hairy (hairs concealed by stipules); rhachis of the leaves covered with shorter and at least partly ± symmetrically medifixed hairs;

peduncles short, at most up to 2.5 cm long, rarely up to 5 cm long (in *A. mucronifolius*); legumes elliptic or obliquely elliptic, carinate ventrally, if rounded (in *A. kentrophyllus*) than leaflets shortly acuminate with a cusp up to 0.5(–1) mm long 3

3. Calyx covered with basifixed to strongly asymmetrically medifixed hairs; standard blade elliptic to widely elliptic, gradually narrowed at the base into the claw 4

– Calyx covered with ± symmetrically medifixed hairs; standard blade suborbicular, subabruptly narrowed at the base into the claw 5

4. Stems of the current year with hairs protruding from the stipules; leaflets long acuminate-aristate, with a cusp up to 6 mm long; legumes with up to 8 seeds *A. fischeri* Fisch.

– Stems of the current year with hairs nearly completely concealed by the stipules; leaflets shortly acuminate-aristate with a cusp up to 3 mm long; legumes with 2–3 seeds *A. mucronifolius* Boiss.

5. Leaflets in 4–5 pairs, elliptic to obovate, 2–3 mm wide; legumes slightly compressed from dorsal side, ca. 6 mm high and 8 mm wide, rounded ventrally and dorsally *A. kentrophyllus* Podlech

– Leaflets in 6–9 pairs; narrowly elliptic, 1–2 mm wide; legumes strongly compressed laterally, 6–6.5 mm high and 3 mm wide, subcarinate ventrally and dorsally *A. talimansurensis* Sirj. & Rech.f.

Astragalus curviflorus Boiss., Diagn. pl. orient., ser. 1, 2: 67. 1843 ≡ *Tragacantha curviflora* (Boiss.) Kuntze, Revis. Gen. 2: 944. 1891. Syntypes: Persia australis, *P.M.R. Aucher-Eloy 4388* (G!, G-BOIS!, K!, OXF!, W!); Persia australis, inter Jaroun [Jahrom] et Darab, *P.M.R. Aucher-Eloy 4391*. Lectotype (PODLECH 1998): *P.M.R. Aucher-Eloy 4391* (G–BOIS!; iso: G!, K!, P!: foto MSB!).

Plants horribly spiny, densely cushion-like shrublets 12–5(–30) cm tall. Main stem up to 6 cm long and up to 5 mm thick, branched, densely covered with remnants of old spines, densely covered with appressed to subappressed short white hairs. Stipules yellowish, 5–6 mm long, from wide base subabruptly narrowly triangular-acuminate, acute but not pungent, adnate to the petiole for 2–3 mm, densely covered at the base and at the margins with subappressed, extremely asymmetrically medifixed hairs, the top often glabrescent or glabrous. Leaves 2–4 cm long; petiole and rhachis stout, up to 1.5 mm thick, rigid, pungent, densely covered with appressed to subappressed, asymmetrically to extremely asymmetrically medifixed hairs up to 0.5 mm long and with much fewer, more ascending hairs up to 0.8 mm long. Leaflets in 4–6 pairs, thickish-leathery, elliptic to obovate, 4–5 × 1.5–2 mm, at the apex abruptly acutish or with a yellowish spine up to 1 mm long, densely covered on both sides with appressed, asymmetrically medifixed hairs up to 0.6 mm long. Peduncles 0.5–1.5 cm long, slender, hairy like the rhachis. Racemes loosely 2–5-flowered. Pedicels 1 mm long. Bracts narrowly triangular 1–2 mm long, densely hairy. Bracteoles ca. 0.5 mm long, in upper part of the pedicel or at the base of calyx. Calyx 5–6 mm long, tubular, attenuate at the base, densely hairy; teeth subulate, 1.5–2 mm long, often somewhat curved, not pungent. Petals pink? Standard 9–10 mm long; blade upcurved above the claw, widely elliptic to nearly circular, 5.5–6 mm wide, slightly retuse at the apex, gradually narrowed into the cuneate short

claw. Wings ca. 9 mm long; blades slightly curved, oblong, obtuse at the apex, 6 × 2 mm; auricle ca. 0.5 mm long, claw curved, ca. 3.5 mm long. Keel 9 mm long; blades elliptic-triangular, with widely curved lower edge and nearly straight upper edge, long acuminate at the apex, 5 × 2.5 mm; auricle short, claw 4.5 mm long. Ovary sessile, pilose, with 4 ovules. Pods sessile, widely elliptic seen from the side, laterally strongly compressed, 5–8 mm long, 4–5 mm high and 2–3.5 mm wide, carinate ventrally, rounded dorsally but with prominent midnerve, at the apex minutely acuminate, unilocular; valves pale brownish, thin but tough, loosely covered with medifixed to subbasifixed, tangled, subappressed hairs 0.1–1 mm long, soon glabrescent. Seed only one.
Distribution: in southwest Iran (Prov. Fars).

Specimens seen:
Iran. Fars: 2 km after Sivand on the road to Abadeh, 1350–1400 m, 14.7.1994, *Chehregani & Zarre 17904* (MSB); circa Kaserun, *Stapf 1071* (WU) – Kuh-i-Bamu, NE of Shiraz, 1830 m, 28.7. 1966, *Archibald 2939* (K); 32 km W Shiraz, 1820 m, *Zohary 477* (HUJ) – prope urbem Shiras, 1842, *Kotschy 58a* (W) – dto.bei Schiras, 16.6.1885, *Stapf* (K, WU) – dto. 23.8.1985, *Stapf* (K) – dto., 27.8.1960, *Zohary 453* (HUJ) – Persepolis, 12.7.1985, *Stapf* (K) – Hadchiabad [Hajiabad], 12.7.1885, *Stapf 1070* (WU) – near Fasa, ca. 150 km SE Shiraz, 7.6.1965, *Ledingham & Assefi 4132* (W) – inter Jaroun [Jahrom] et Darab, *Aucher-Eloy 4391* (G, G–BOIS, K, P) – Lake Maharlu, 35 km SE of Shiraz, 1500 m, 18.11.1963, *Grant 15082* (W) – Takht-e Jamshid, above the ruins, 22.5.1959, *Wendelbo 786* (BG) – in montibus 12 km NW Hoseynabad, 37 km ab opp. Darab, 30.5.1973, *Soják 5043, 5047* (PR) – Kotal Komared, 4.5.1885, *Stapf 685* (K).

Astragalus fischeri Fisch., Bull. Soc. Imp. Naturalistes Moscou 26(2): 429. 1853. Type: [bei Gäsnabad, 12.5.1849], *F.A. Buhse 1413* (H!).
= *A. phyllokentrus* Hausskn. & Bornm., Mitth. Thüring. Bot. Vereins, n.s. 23: 11. 1908. Syntypes: Persia occ., in monte Latetar, 10.6.1895, *Th. Strauss* (B!: foto K!, JE!); et ad Gulpaigan, vi.1899, *Th. Strauss*; Tschchar-Khatun, ditionis montis Raswend, vi.1902, *Th. Strauss* (B!, G!, K!, W!). Lectotype (PODLECH, designated here): In dit. urbis Sultanabad, Gulpaigan, vi.1899, *Th. Strauss* (JE!; iso: B!, K!, W!, Z!).
= *A. cornu-caprae* Sirj. & Rech.f., Anz. Österr. Akad. Wiss., Math.–Naturwiss. Kl. 1954 (91): 171. 1954. Holotype: [Iran] entre Gomsche et Yezd-i Khast, route d'Ispahan à Chiraz, à 200 km SE de Ispahan, 1800 m, 11.6.1930, *J. Gautier 14* (P!: foto MSB!).

Plants spiny, cushion-like shrublets up to 30 cm tall, with only white hairs. Caudex up to 10 mm in diameter, with short, dark brown branches, in upper part covered with remnants of old leaves. Stems of the year 1–2 cm long, densely covered with ascending, fine, subbasifixed white hairs up to 2.5 mm long, protruding well from the upper stipules. Stipules membraneous, 8–12 mm long, triangular-acuminate, not spiny, distinctly reticulately nerved, adnate to the petiole for 2–4 mm, sometimes only densely ciliate at the margins with basifixed hairs up to 1 mm long, otherwise glabrous or hairy also on the outer surface. Leaves 4–25 cm long, in the lower 2.5–6 cm without leaflets; petiole and rhachis up to 2.5 mm thick, rigid, pungent, sparsely to rather densely covered with appressed short, ± medifixed hairs 0.2–0.3 mm long and with asymmetrically medifixed to subbasifixed hairs up to 1 mm long, often soon glabrescent or glabrous. Leaflets in 3–6 pairs, thickish-leathery, elliptic to obovate, at the apex abruptly acuminate into a spine 1.5–6 mm long, 8–15 × 5–9 mm, prominently nerved, on

upperside densely, on underside sparsely to loosely covered with appressed ± medifixed hairs 0.4–0.8 mm long. Peduncles 1–2 cm long, sparsely hairy or glabrous. Racemes loosely 2–15-flowered, later on often elongated and up to 9 cm long. Bracts membraneous, narrowly triangular to linear, 1–3 mm long, ciliate. Pedicels 1 mm long. Bracteoles ca. 1 mm long, in upper part of the pedicel or at the base of calyx. Calyx campanulate, 6–7 mm long, glabrous or very sparsely hairy; teeth narrowly triangular to subulate, 2–4 mm long, acuminate-pungent. Petals pink. Standard 12–14 mm long; blade upcurved above the claw, widely elliptic, 8 mm wide, slightly retuse at the apex, gradually narrowed into the cuneate, short claw. Wings 10–14 mm long, slightly curved; blades oblong, rounded at the apex, 8.5 × 3 mm; auricle ca. 0.5 mm long, claw curved, ca. 5.5 mm long. Keel 9–12 mm long; blades elliptic-triangular, with widely curved lower edge and straight upper edge, acute at the apex, 5.5–6 × 3.5 mm; auricle short, claw 6.5 mm long. Ovary sessile, hairy. Pods sessile, obliquely elliptic, straight to slightly curved, 10–20 mm long, 3.5–6.5 mm high and 3–4 mm wide, obtusely carinate by the thick median nerve ventrally, carinate or rounded dorsally but with prominent midnerve, at the apex shortly acuminate, unilocular; valves brownish, thick, with obliquely transverse-reticulate nerves, loosely covered with extremely asymmetrically medifixed to subbasifixed ascending hairs 0.8–1(–2) mm long, becoming glabrescent. Seeds up to 8, irregularly triangular to rectangular, 3.5 × 3 mm, brown, slightly pitted.
Distribution: In southwest and central Iran.

Specimens seen:
Iran. Markasi: in ditione urb. Sultanabad [Arak], Gulpaigan, vi.1899, *Strauss* (B, JE, K, W, Z) – near Arak, 1520 m, 2.4.1963, *Bowles sholarship Bot. Exp. 610* (K) – 60 km from Delijan to Qum, 1140 m, 23.5.1972, *Amin & Mousavi 16119* (W) – in monte Tschchar Khatun (dit. Raswend), VI.1902, *Strauss* (W) – inter Teheran et Dilijan, 500–1000 m, 23.4.1956, *Schmid 5158* (M) – 10 miles W Qom, 27.4.1961, *Stutz 747* (W) – 15 km S Qom, 1130 m., 22.4.1961, *Pabot 12436-E* (W) & *5669* (G). – Esfahan: Julfa, Armenia cemetry, 29.5.1959, *Wendelbo 909* (BG) – dto., 20.4.1948, *Rechinger, Aellen & Esfandiari 2688* (K, M, W) – 60–70 km ab Ardestan boreo-occidentem versus inter Ab-i Azan (Abyazan) et Rahmatabad, 1150 m, 26.5.1974, *Rechinger 46504* (M, W) – Iahabad, 20 km NW Najafabad, 45 km W Esfahan, 1900 m, 12.6.1965, *Ledingham & Assefi 4140* (W) – 2 km N Najafabad, 12.6.1965, *Ledingham & Assefi 4134* (W) – 14 km SE Natanz, 1480 m, 12.5.1961, *Pabot 7175* (G, W) – road from Natanz to Ardestan, near Emamzade Abyazan, 1380 m, 15.5.1974, *Wendelbo & Foroughi 11462* (W) – 24 km NE Murcheh Khvort, 1750 m, 27.5.1974, *Rechinger 46638* (M, W) – 70 km NW Nain versus Ardestan, 1700 m, 18.5.1975, *Rechinger 52022* (M, W) – Ardestan to Nain, 29.11.1956, *Sabeti 12085-E* (W) – Isfahan district, 1500–1800 m, *Trott* (K) – Kuh-i-Shir, 7 km SW Isfahan, 1650 m, 27.4.1953, *Soder 216* (W) – Ispahan, *Aucher-Eloy 4400* (K) – 10 km W Esfahan, 1600 m, 28.5.1960, *Pabot 3465* (G) – 27 km S Esfahan, 1700 m, 24.4.1961, *Pabot 5753* (G) – 65 km SW of Esfahan, 1400 m, 22.4.1929, *Cowan & Darlington 1166* (K) – 10 km SE Nain, 1530 m, 11.5.1961, *Pabot 7104* (G, W) – 70 km NE Nain, 1700 m, 18.5.1975, *Iranshahr 41057-E* (W) – 43 km NW Nain, 1970 m, 11.5.1961, *Pabot 7112* (G). – Yazd: ad pagum Seinudin, 1600–1700 m, 11.4.1892, *Bornmüller 3710* (K, W) – 54 km S Mahallat to Golpaiegan, 1750 m, 16.5.1973, *Babakhanlu & Amin 15271*(W). – Fars: entre Gomsche et Yezd-i Khast, route d'Ispahan à Chiraz, à 200 km SE de Ispahan, 1800 m, 11.6.1930, *J. Gautier 14* (P) – zwischen Jezdikhast und Aminabad, 11.9.1885, *Stapf 1008* (WU) – bei Jezdikhast, 11.9.1985, *Stapf 1008* (WU) – 16 km W of Abarqu, 1600 m, 3.4.1964, *Grant 15410* (W) – N of Abadeh, 2100 m, 22.4.1966, *Archibald 1473* (K) – Abadeh, 1800 m, 12.5.1915, *Pravitz 727* (W) – entre Abadeh et Daulatabad, 1500–2000 m, 26.4.1956, *Schmid 5235* (G) – 30 km SE Abadeh, 1810 m, 26.4.1961, *Pabot 5814* (G).

Astragalus kentrophyllus Podlech, Sendtnera 6: 156, 1999. Holotype: Iran, Prov. Khuzestan: 25 km N of Haftgel towards Izeh, 550 m, 25.5.1973, *Iranshahr & Mousavi 15593-E* (W!).

Plants spiny, cushion-like shrublet up to 15 cm tall, in most parts densely covered with appressed, ± symmetrically medifixed, white hairs. Caudex up to 10 mm in diameter, with short, dark brown branches, in upper part covered with remnants of old leaves. Stems of the year 1–3 cm long, the dense indumentum of fine, basifixed white hairs up to 1 mm long is not visible because of the very dense cover of leaves with their stipules. Stipules pale yellowish, 5–8 mm long, triangular-acuminate, shortly spiny, distinctly reticulately nerved, adnate to the petiole for 3–5 mm, sparsely ciliate at the margins with basifixed hairs up to 0.3 mm long, otherwise glabrous. Leaves 5–12 cm long, in the lower half to two third without leaflets; petiole and rhachis up to 1 mm thick, rigid, pungent, densely covered with appressed hairs 0.2–0.6 mm long. Leaflets in 4–5 pairs, thickish-leathery, elliptic to obovate, 4–7 × 2–3 mm, at the apex abruptly acuminate into a minute spine up to 0.5(–1) mm long, on upperside densely, on underside loosely to rather densely covered with appressed, symmetrically medifixed hairs 0.3–0.5 mm long. Peduncles 1–1.5 cm long, curved, hairy like the rhachis. Racemes loosely 3-flowered. Bracts whitish-hyaline, narrowly triangular, 2 mm long, ciliate. Pedicels at fruiting time thickish, 3–4 mm long, rather densely hairy. Bracteoles 0.5–1.5 mm long, linear, in the upper part of the pedicel. Calyx campanulate, ca. 7 mm long, obliquely cut at the mouth, rather densely covered with short, ± symmetrically medifixed hairs, at the upper margins and teeth with basifixed cilia; teeth narrowly triangular, 3–3.5 mm long, acuminate but not pungent, with elevated midnerve. Standard 13 mm long; blade upcurved above the claw, suborbicular, 7 mm wide, emarginate at the apex, subabruptly narrowed into the wide claw. Wings 11–12 mm long, slightly curved; blades oblong-obovate, rounded at the apex, 6 × 3 mm; auricle ca. 1 mm long, claw curved, 5–6 mm long. Keel 11–12 mm long; blades strongly obliquely elliptic-curved, with very widely rectangular-curved lower edge and concave upper edge, acute at the apex, 5–6 × 3–3.5 mm; auricle 0.5 mm long, claw 6 mm long. Pods sessile, elliptic, straight, 12–15 mm long, 6 mm high and 8 mm wide, flat ventrally, widely rounded dorsally, at the apex very shortly acuminate, unilocular; valves pale brownish, thick, slightly rugulose, covered with appressed, very short, ± symmetrically medifixed hairs and with distinctly longer, strongly asymmetrically medifixed hairs up to 0.8 mm long, soon glabrescent and nearly glabrous with age. Seeds 3, nearly globular, 5 × 4 × 3 mm, pale brownish, smooth.
Distribution: S.W. Iran, endemic. Occurence: on gypsaceous soil

Specimens seen:

Iran. Ilam: 10 km S of Zarrin-Abad, Anaran Mountain, 1200–1300 m, 6.8.1989, *Akhani 5540* (MSB). – Khuzestan: 11 km W Haft-Kel, 300 m, 13.3.1959, *Pabot 315* (G) – 25 km N of Haftgel towards Izeh, 550 m, 25.5.1973, *Iranshahr & Mousavi 15593-E* (W) – 8 km W Behbehan, 15.4.1959, *Pabot 12435-E* (W) & *621* (G) – Zeydoun, 65 km SE Soveyreh, road from Mahshahr to Genaveh, 350 m, 29.2.1972, *Iranshahr & Termeh 14957-E* (W) – Anhal, 47 km from Masdjed-Suleiman to Lali, 16.3.1978, *Iranshahr & Termeh 14964-E* (W). – Boyer Ahmadi: 45 km from Dogonbadan to Behbehan, 500 m, 3.3.1972, *Iranshahr & Termeh 40843-E* (W). – Fars: 4 km S Fahlian, 900 m, 10.5.1959, *Pabot s.n.* (G) – bei Kaserun, 8.5.1885, *Stapf 1068* (K, WU) – Kazerun to Rudak, 800 m, 10.4.1974, *Davis & Bokhari D.56516* (K) – Kotal Komarech, 4.5. 1885, *Stapf 1143* (WU).

Astragalus mucronifolius Boiss., Diagn. pl. orient., ser. 1, 2: 68. 1843 ≡ *Tragacantha mucronifolia* (Boiss.) Kuntze, Revis. Gen. 2: 946. 1891. Holotype: [Iran] Persia prope Ispahan, *P.M.R. Aucher-Eloy 4400* (G-BOIS!; iso: BM!, G!, LE!, OXF!, P!, W!).

= *A. mucronifolius* var. *brevidentatus* Sirj. & Rech.f., Ann. Naturhist. Mus. Wien 58: 72. 1951 ≡ *A. mucronifolius* f. *brevidentatus* (Sirj. & Rech.f.) Parsa, Fl. Iran 9: 132. 1966. Holotype: [Iran] Inter Jezd et Kermanshahan, 22.–23.4.1948, *K.H. Rechinger, P. Aellen & E. Esfandiari 2842* (W!; iso: B!, E!, G!, IRAN, K!).

= *A. taftanicus* Parsa, Kew Bull. 1948: 195. 1948. Holotype: [Iran] S. Persia, Taftan (South), 2200 m, 9.5.1939, *A. Parsa 658* (K!).

= *A. taftanicus* var. *multiflorus* Parsa, Kew Bull. 1948: 196. 1948. Holotype: [Iran] S. Persia, Shiraz, Khafr, 12.4.1939, *A. Parsa* (K!).

Plants spiny, cushion-like shrublet up to 12 cm tall, with appressed to subappressed, symmetrically to strongly or extremely asymmetrically medifixed or subbasifixed, merely white hairs. Caudex up to 10 mm in diameter, with short, dark brown branches, in upper part covered with remnants of old leaves . Stems of the year 1–2 cm long, the dense indumentum of fine, subbasifixed white hairs up to 2 mm long is not visible because of the very dense cover of leaves with their stipules. Stipules pale yellowish, 5–11 mm long, triangular-acuminate, shortly spiny, distinctly reticulately nerved, adnate to the petiole for 3–5 mm, densely ciliate at the margins with basifixed hairs up to 0.5(–1) mm long, otherwise mostly glabrous. Leaves 6–15 cm long, in the lower half without leaflets; petiole and rhachis up to 2 mm thick, rigid, pungent, sparsely to loosely covered with appressed, irregularly medifixed hairs 0.4–0.7 mm long, often soon glabrescent to glabrous. Leaflets in 3–6 pairs, thickish-leathery, narrowly elliptic or elliptic to obovate, 6–10 × 2–7 mm, at the apex abruptly to subabruptly acuminate into a spine 1.5–3 mm long, prominently nerved, on upper side rather densely, on underside sparsely to loosely covered with subappressed, symmetrically to strongly asymmetrically medifixed hairs up to 1 mm long. Peduncles 1–2.5 cm long, sparsely to rather densely hairy. Racemes loosely 3–10-flowered. Bracts whitish-hyaline, narrowly triangular, 1–2 mm long, ciliate. Pedicels 1–1.5 mm long, sparsely hairy. Bracteoles 0.5–1.5 mm long, linear, at the base of calyx. Calyx campanulate, 6–7 mm long, sparsely covered with extremely asymmetrically medifixed and basifixed hairs 0.2–0.5 mm long; teeth narrowly triangular, ca. 3 mm long, acuminate-pungent, with elevated midnerve. Petals pink, the keel whitish. Standard 12–14 mm long; blade upcurved above the claw, elliptic, 7 mm wide, slightly retuse at the apex, gradually narrowed into the cuneate short claw. Wings 11–13 mm long, slightly curved; blades oblong, rounded at the apex, 7 × 3 mm; auricle ca. 1 mm long, claw curved, 5–6 mm long. Keel 10–12 mm long; blades obliquely elliptic-triangular, with widely curved lower edge and straight upper edge, acute at the apex, 5 × 3 mm; auricle 0.5 mm long, claw 6–7 mm long. Ovary sessile, villous; style glabrous. Pods sessile, obliquely elliptic to elliptic, straight, 10–12(–15) mm long, 4–6(–9) mm high and 3.5–5(–6) mm wide, obtusely carinate by the thick median nerve ventrally, carinate or rounded dorsally but with prominent midnerve, at the apex shortly acuminate, unilocular; valves brownish, thick, slightly transversely rugulose-nerved, covered with very fine subappressed to ascending hairs up to 1 mm long, soon glabrescent and often glabrous when ripe. Seeds 2–3, rectangular, 3 × 2 mm, brown, irregularly pitted.

Distribution: In southwest, southeast and central Iran.

Specimens seen:

Iran. Esfahan: inter Ab-i Azan (Abyazan) et Rahmatabad, 60–70 km NW Ardestan, 1150 m, 26.5.1974, *Rechinger 46504* (M, W) – 15 km SW of Isfahan, 4.6.1974, *Alava 13536* (TUR) – Kouhhaye Kolah-Ghazi, 40 km from Esfahan to Shiraz, 1700–2000 m, 6.6.1984, *Termeh & Tehrani 41408-E* (W) – Natanz, 1500 m, 19.5.1975, *Rechinger 52058* (M, W) – 20' SE of Esfahan, 1730 m, 11.4.1962, *Furse 1361* (K, W) – prope Ispahan, *Aucher-Eloy 4400* (BM, G, G-BOIS, LE, OXF, P, W) – between Aran and Kashan, 850 m, 28.4.1974, *Dinie & Bazargan 7972* (W). – Fars: pr. Schiras, 10.5.1842, *Kotschy 354* (MSB, WU) – pr. Gere inter Abuschir et Schiras, 18.3.1842, *Kotschy 58* (MSB, WU) – Shiraz, Khafr, 12.4.1939, *Parsa* (K)! Jahrom, *Koelz 14606* (W) – Sarvestan, *Gauba 525* (W). – Kerman: entre Bam et Jiroft, 1450 m, 19.4.1972, *Léonard 5617* (K, M, MSB, W) – 9 km N Kerman, 1790–1900 m, 8.5.1961, *Pabot 6952* (G) – 3 km NE Sirjan, 1720 m, 7.5.1961, *Pabot 6852* (G) – Bashagard, Ghorichi, 1000 m, 20.2.1973, *Iranshah & Mousavi 15466-E* (W) – 150 km SE Kerman versus Bam, 26.3.1965, *Rechinger 27152* (W) – Mahan, entre Kerman et Bam, 13.6.1960, *Dadashzadeh DK430* (G) – 24 km S Mahan, 26.3.1965, *Rechinger 27147* (K, M, W) – inter Mashiz et jugum Khan-e Sorck (inter Kerman et Sirdjan), 2000–2580 m, 27.4.1948, *Rechinger, Aellen & Esfandiari 3031* (W) – 6 km from Darzin on the road to Jiroft, 1450 m, 14.4.1975, *Foroughi 15908* (W) – prope Kerman, IV.1859, *Bunge* (K) – S. of Kerman, 26.3.1965, *Lamond 75* (M) – hills S of Deh Bakri, 1150–1700 m, 1.5.1975, *Parris 74.264* (K) – 4 km SW of Baft, 2000 m, 2.5.1975, *Parris 75.319* (K). – Markasi: 42 km from Qum to Arak, 1360 m, 21.5.1972, *Amin & Mousavi 15961* (W). – Semnan: 30 km SW of Damghan, 1200 m, 5.5.1974, *Wendelbo & al. 11217* (H, W) – 20 km E of Damghan, 1100 m, 5.5.1974, *Wendelbo & al. 11191* (W). – Sistan: Khash, Karavandar Gebirge, 1.4.1949, *Mirzajan 583-E* (W) – Gebirge bei Khash, 26.3.1949, *Mirzajan 581-E* (W) – Sangan, Ladis road, 1550 m, 15.3.1974, *Foroughi 10819* (W) – Sangan, between Khash and Ladis, 1500 m, 15.3.1974, *Iranshahr & Ershad 16332-E* (W) – 76 km NE from Zarbaz versus Qale Zaboli, 1200 m, 11.3.1974, *Iranshahr & Ershad 16357-E* (W) – prope pag. Deh Pabid, 1420 m, 28.3.1973, *Soják 307* (PR) – prope opp. Khash, 28.3.1973, *Soják 461* (PR) – in declivibus australibus vulcani Taftan prope Torshab, 1900–2300 m, 26.4.1977, *Rechinger 54782* (W) – dto., 2500–2700 m, *Assadi* in Hb. Rechinger *54838* (M, W), *54839* (M, W). – Yazd: inter Yezd et Kermanshahan, 22.–23.4. 1948, *K.H. Rechinger, P. Aellen & E. Esfandiari 2842* (B, E, G, IRAN, K, W).

Astragalus ovoideus Sirj. & Rech.f., Ann. Naturhist. Mus. Wien 58: 72. 1951 ≡ *A. mucronifolius* Boiss. var. *ovoideus* (Sirj. & Rech.f.) Parsa, Fl. Iran 9: 131. 1966. Holotype: [Iran] Prov. Kerman, Montes Djamal Bariz inter Bam et Djiroft, infra Deh Bakri, ca. 1800 m, 8.–10.5.1948, *K.H. Rechinger, P. Aellen & E. Esfandiari 3865* (W!; iso: E!, G!).

= *A. mucronifolius* Boiss. subsp. *robustus* Sirj. & Rech.f., Ann. Naturhist. Mus. Wien 58: 71. 1951 ≡ *A. mucronifolius* var. *robustus* (Sirj. & Rech.f.) Parsa, Fl. Iran 9: 131. 1966. Holotype: [Iran] Prov. Kerman, inter Saidabad et jugum Chah Choghuk, 1700–1900 m, 28.4.1948, *K.H. Rechinger, P. Aellen & E. Esfandiari 3172* (W!; iso: B!, E!, G!, K!, M!).

Plants nearly acaulescent, caespitose-spiny, up to 25 cm tall, sparsely covered with appressed to subappressed, partly asymmetrically to extremely asymmetrically or even subbasifixed white hairs 0.3–1(–1.5) mm long. Caudex branched with short to elongated branches up to 6 cm long, densely covered with remnants of old stipules and rhachides. The very short stems densely hairy. Stipules thickish, whitish to straw-coloured, 5–10 mm long, narrowly triangular, with distinct longitudinal nerves, adnate to the petiole for 1–3 mm, ciliate at the margins, at the base covered with long basifixed white hairs, otherwise glabrous, more rarely appressed hairy. Rhachis strong, at the base up to 2 mm thick, pale greenish, (4–)6–18 cm long, pungent, finely striate-sulcate, sparsely hairy to glabrescent, with fine, extremely asymmetrically medifixed hairs up to 1.5 mm long, the lower half or 2/3 without leaflets, the

free apex 1–3 cm long. Leaflets in 3–5 pairs, remote, rigidly thickish, narrowly to widely elliptic or obovate, 5–10 × 2–6 mm, shortly acuminate and with a yellowish cusp 1.5–3 mm long, the midvein on underside prominent, yellowish, both sides loosely to rather densely covered with appressed, asymmetrically to more rarely symmetrically medifixed hairs up to 1 mm long. Peduncles 2–8 cm long, curved, hairy like the rhachis. Racemes 3–12-flowered, at fruiting time elongated and up to 8 cm long. Bracts whitish-hyaline, 1–2 mm long, narrowly triangular, ciliate with basifixed hairs. Pedicels ca. 1 mm long, hairy. Calyx 5–7 mm long, campanulate-tubular, sparsely covered with subbasifixed hairs up to 1 mm long; teeth from the narrowly triangular base long acuminate, somewhat pungent, 2–4 mm long. Petals pink, the standard with darker longitudinal stripes. Standard 10–13 mm long; blade obovate to nearly orbicular, 6–8 mm wide, slightly retuse at the apex, gradually narrowed into the short claw. Wings 10–12 mm long; blades narrowly obovate, slightly curved, rounded at the apex, 8 × 3 mm; auricle ca. 1 mm long, claw 4.5 mm long. Keel 9–10 mm long; blades triangular, with widely rectangular-curved lower edge and ± straight upper edge, acutish at the apex, 5 × 3 mm; auricle short, claw 5 mm long. Pods sessile, ovoid, 9–15 mm long, 7–11 mm high and 7–10 mm wide, ventrally and dorsally with prominent flat vein, at the apex with a minute beaklet, unilocular; valves hard, brownish, finely and densely transversely rugulose-veined, rather densely covered with fine, ascending, basifixed hairs up to 2 mm long and with few very short, medifixed, appressed hairs, soon glabrescent and mostly completely glabrous when fully ripe. Seeds 4–5, nearly quadrangular, 3 × 3 mm, greyish, densely irregularly rugulose-pitted.
Distribution: In southwest, south and central Iran.

Specimens seen:

Iran. Fars: 25 km W of Shiraz, 28.8.1960, *Zohary 583* (HUJ) – Dudehak, 25 km NW of Shiraz, 1900 m, 8.6.1965, *Grant 17668* (W) – 20 km N Shiraz, 1760 m, 28.4.1961, *Pabot 6013* (G) – 27 km N Shiraz, 1630 m, 28.4.1961, *Pabot s.n.* (G) – 10 km SW of Shiraz, 1600 m, 12.4.1964, *Grant 15498* (W) – entre Shiraz et Persepolis, 800–1000 m, 2.5.1956, *Schmid 5513* (W) – 53 km NW Jahrom vers Shiraz, ca. 1100 m, 30.4.1961, *Pabot 6292* (G) – 75 km SE Shiraz, 1450 m, 30.4. 1961, *Pabot 6240* (G, W) – 80 km SE Shiraz, 1430 m, 30.4.1961, *Pabot 6249* (G) – 12 km N Shiraz, 30.5.1965, *Ledingham & Assefi 4075* (W) – 25 km E Lar, 660 m, 2.5.1961, *Pabot 6442* (G).– Hormozgan: Hajiabad, 134 km S Sirjan, 1290 m, 6.5.1961, *Pabot 40815-E* (W) & *6795* (G). – Kerman: 3 km NE Sirjan, 1720 m, 7.5.1961, *Pabot 6851* (G) – 20 km NE Sirjan, 1820 m, 7.5.1961, *Pabot 6861* (G) – inter Saidabad et jugum Chah Choghuk, 1700–1900 m, 28.4.1948, *Rechinger, Aellen & Esfandiari 3172* (B, E, G, K, M, W) – zwischen Sirjan und Hajjiabad, 5.6.1976, *Manutshehri 508* (MSB) – Djiroft, 2.4.1965, *Soltan 6390-E* (W) – Montes Djamal Bariz inter Bam et Djiroft, infra Deh Bakri, ca. 1800 m, 8.–10.5.1948, *Rechinger, Aellen & Esfandiari 3865* (E, G, W) – 40 km S Kerman, 1500 m, 1.4.1964, *Grant 15393* (W) – prope Mahan, 1800 m, 6.5.1977, *Rechinger 55242* (M, W) – prope opp. Mahan, 1700 m, 24.3.1973, *Soják 177* (PR) – inter Chabbis [Shahdab] et Kerman, IV.1859, *Bunge* (K). – Khuzestan: N of Dezful, above Damsite, 600 m, 28.3.1959, *Wendelbo 55* (BG) – Near the big Dez dam [N Dezful], 600 m, 28.3.1959, *Wendelbo 55* (BG). – Sistan: 12 km SE a vico Bazman, 13.4.1973, *Soják 1910* (PR) – inter Khash et Iranshahr, 1600 m, 17.5.1948, *Rechinger, Aellen & Esfandiari 4041* (W) – Iranshahr, 25.2.1949, *Sharif 592-E* (W) – Iranshahr to Bam, Kuh-e Pansareh, 25 km N Bazman, 900–1300 m, 27.4.1983, *Termeh, Moussavi & Tehrani 41101-E* (W) – Kahnouk, btween Zahedan and Khash, 1700 m, 22.4.1983, *Termeh, Moussavi & Tehrani 41108-E* (W).

Astragalus talimansurensis Sirj. & Rech.f., Anz. Österr. Akad. Wiss., Math.-Naturwiss. Kl. 1953 (90): 180. 1953 ≡ *A. mucronifolius* Boiss. var. *talimansurensis* (Sirj. & Rech.f.) Parsa, Fl. Iran 9: 131. 1966. Holotype: [Iran] Bakhtiari, Talimansur, 28.4.1940, *W. Koelz 15090* (W!: foto K!).

Plant spiny, cushion-like shrub up to 15 cm tall (up to 45 cm tall according to the collector), in most parts densely covered with appressed to subappressed, ± symmetrically to more rarely asymmetrically medifixed white hairs 0.3–1 mm long. Old stems thick, blackish, covered with remnants of old leaves, the stems of the year 1–2 cm long, the dense indumentum of fine, subbasifixed white hairs up to 1 mm long is not visible because of the very dense cover of leaves with their stipules. Stipules pale yellowish, 6–8 mm long, triangular-acuminate, not spiny at the tip, adnate to the petiole for ca. 3 mm, densely ciliate at the margins with basifixed hairs up to 0.5 mm long, otherwise mostly glabrous. Leaves 3–7 cm long, in the lower half without leaflets; petiole and rhachis up to 1 mm thick, pungent, densely covered with appressed to subappressed, irregularly medifixed hairs 0.2–0.6 mm long. Leaflets in 6–9 pairs, narrowly elliptic to elliptic, 4–6(–7.5) × 1–2 mm, at the apex subabruptly acuminate into a spine 0.5–1 mm long, on both sides densely covered with appressed to subappressed, mostly ± symmetrically medifixed hairs up to 0.5(–0.8) mm long. Peduncles 1–2 cm long, densely hairy. Racemes loosely 2–4-flowered. Bracts whitish, narrowly triangular, ca. 2 mm long, ciliate. Pedicels at fruiting time thickish, ca. 3 mm long, hairy. Bracteoles 1.5 mm long, linear, in upper part of the pedicel. Calyx campanulate, ca. 7 mm long, loosely covered with ± symmetrically medifixed, short hairs; teeth narrowly triangular, ca. 3 mm long, acuminate, scarcely pungent, with elevated midnerve. Petals pink. Standard ca. 12 mm long; blade suborbicular, ca, 8 mm wide, subabruptly narrowed into the short claw. Wings ca. 11 mm long, blades narrowly oblong, rounded at the apex, 5 × 1.5 mm; auricle ca. 1 mm long, claw 6 mm long. Keel 10 mm long; blades obliquely elliptic-triangular, with widely curved lower edge and nearly straight upper edge, acute at the apex, 5 × 2 mm; auricle 0.5 mm long, claw 5 mm long. Pods sessile, elliptic, straight, 15–17 mm long, 6–6.5 mm high and 3 mm wide, carinate ventrally and dorsally, at the apex shortly acuminate, unilocular; valves pale brownish, thick, slightly transversely rugulose, rather densely covered with very short subappressed hairs.
Distribution: Iran, endemic; known only from the type.

Specimen seen:
Iran. Chahar Mahal Bakhtiari: Talimansur, 26.4.1940, *Koelz 15090* (W).

Excluded species:

The following species, which are included into the section by RECHINGER, DULFER & PATZAK do not belong to *Leucocercis*:

Astragalus semnanensis Bornm. & Rech.f. has only basifixed hairs, persistent petals in fruit and hairy standard. It is the representant of the monotypic sect. *Semnanenses* Podlech & Zarre.

Astragalus crassispinus Bunge was described by the author based on a plant without flowers and fruits. Because of superficial similarities it was erroneously assigned to section *Leucocercis*. It has only basifixed hairs and clearly belongs to the plant which was later on described as *A. noziensis* Sirj. & Rech.f. of sect. *Anthylloidei* (RECHINGER 1958).

VIII. New typifications and changes of typification in *Astragalus*-species.

A. angarensis Bunge 1868, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 126 in clave [et l.c. 15(1): 222. 1869]. – **Lectotype** (Flora USSR 1946): [Russia] Sibiria baicalensis ad Angaram prope Balagansk, [1830], *P.K.N.S. Turczanninov* (LE!; iso: BR!, C!, G!, H!, HAL!, K!, LE!, M!, OXF!, P!, W!, WAG!). The lectotypification by PODLECH 1998 with the type in P is superfluous because the type is indicated in Fl. USSR 1946 as to be in LE.

A. coronilloides Ulbr. 1913, Bot. Jahrb. Syst. **1**, Beibl. 110: 14. – **Lectotype** (designated here): Zentral-China, West-Hupeh, Fang, vii.1901, *E.H. Wilson 2386* (K!; iso: E!, P!, W!).

A. crassispinus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 132(1868) in clave [et l.c. 15(1): 230. 1869]. Holotype: Afghanistan, *W. Griffith* distr. no. *1592* (K). Although the type of *A. crassispinus* has no flowers and fruits there can be no doubt about the identity with *A. noziensis* Sirj. & Rech.f., Dansk Biol. Skr. 9(3): 124. 1958. An epitype has to be choosen to show the important characters of the flowers and fruits. – **Epitype** (designated here): Afghanistan, Prov. Ghazni, Okak, NE altoplanitiei Dasht-e Nawar, ca. 3000 m, ca. 33°50' N, 67°55' E, 4.7.1962, *K.H. Rechinger 17760* (as *A. noziensis*) (M; iso: W).

A. cuscutae Bunge var. ***pulcher*** Beck 1886, Denkschr. Kaiserl.. Akad. Wiss., Math.-Naturwiss. Kl. 51: 339. Syntypes: [Iran] prope Kaebuterchan, 1882, *Th. Pichler*, ac inter Hamadan et Tschitschian. – **Lectotype** (designated here): near Käbuterchan [Kabutarahang], 2130 m, 14.5.1982, *Pichler* (W!; iso: K!).

A. cytisoides Bunge 1868, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 128 in clave [et l.c. 15(1): 224. 1869]. – **Lectotype** (Flora USSR 1946): [Kazakhstan] Karatau occ. Turkestaniae, 5000', 11.5.1866, *N.A. Sewerzow* (LE!; iso: G-BOIS: fragment!, P!. The lectotypification by PODLECH 1998 with the type in P is superfluous because the type is indicated in Fl. USSR 1946 as to be in LE.

A. dilutus Bunge, Del. Sem. Dorpat. 1840: 7. 1840. – **Lectotype** (Fl. URSS 1946): ad rivulum Tuktugem in deserto Tschujae, 10.7.1839, *A. Politov* (LE!; iso: K!, P!, TUB!). The lectotypification by PODLECH 1998 with the type in P is superfluous because the type is indicated in Fl. USSR 1946 as to be in LE.

A. feddei Sirj. 1943, Repert. Spec. Nov. Regni Veg. 52: 229. – **Lectotype** (designated here): Armenia turcica, Egin, Kota, 6.6.1890, *P.E.E. Sintenis 2568* (W!; iso: B!, BR!, K!, LE!, M!, MSB!, WU!).

A. gypsaceus Beck var. ***angustifolius*** Bornm. 1910, Beih. Bot. Centralbl. 27(2): 332. – **Lectotype** (designated here): [Iran] in monte Elwend, *Th. Strauss* (JE!; iso: B!). The lectotype has been named holotype in PODLECH 1988. Because there is a specimen seen by Bornmüller also in B, a lectotypification is necessary.

A. kadschorensis Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 103 in clave [et l.c. **15(1)**: 182. 1869]. – **Lectotype** (Flora USSR 1946): Iberia caucasica prope Tiflis, Kadshory, supra ruinas Ker-ogly, 5.6.1866, *A.P. Owerin* LE!; iso: G-BOIS!, P!). The lectotypification by PODLECH 1998 with the type in P is superfluous because the type is indicated in Fl. USSR 1946 as to be in LE.

A. leansanicus Ulbr., Bot. Jahrb. Syst. 36, Beibl. 82: 62. 1905. Type: [China] Shaanxi merid., in monte Lean shan, *Giraldi 4241* (B: destroyed: at K a good drawing and fragment). – **Lectotype** (designated here): *Giraldi 4241*: the drawing in connection with the fragment at K!; iso: W!: fragment.

A. lepsensis Bunge 1868, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 25 in clave [et l.c. 15(1): 29. 1869]. – **Lectotype** (Flora USSR 1946): [Kazakhstan] jugo Alatau ad fl. Lepsa et Sarchan, *G.S. Karelin & I.P. Kirilov 1362* (LE!; iso: BM!, K!, LE!, M!, P!, W!). The lectotypification by PODLECH 1998 with the type in P is superfluous because the type is indicated in Fl. USSR 1946 as to be in LE.

A. leptothalamus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 135. 1868 [et l.c. 15(1): 232. 1869]. – **Holotype**: [Turkey] ad ripas Sari prope Karakoi ad montem Argaeum Ciliciae, 4500', 26.5.1859 *Th. Kotschy suppl. 198* (G-BOIS!; iso: HUJ!, P!: foto MSB!, W!). The lectotypification by PODLECH 1998 with the type in P is superfluous, because BUNGE quotes the specimen in hb. Boissier only.

A. leucophanus Bornm. 1906, Beih. Bot. Centralbl. 19(2): 242. – **Lectotype** (designated here): [Iran] Hamadan, in monte Elwend, v.1897, *Th. Strauss* (B!; iso: JE!).

A. macropus Bunge 1847, Arbeiten Naturf. Vereins Riga 1: 238. Syntypes: im Gouvern. Orenburg bei Spaskoje, 4.6.1839 (K!); am Flusse Ilek, 22.5.1841, *A. Lehmann*. – **Lectotype** (designated here): am Flusse Ilek, 22.5.1841, *A. Lehmann* (LE!; iso: K!). No specimen at P. Syntypes have been distributed as Rel. A. Lehmann. no. 351 (K!).

A. macrotropis Bunge 1868, Mém. Acad. Imp. Sci. Saint Petersbourg 11(16): 127 in clave [et l.c. 15(1): 223. 1869]. – **Lectotype** (Flora USSR 1946): [Kazakhstan] Songaria, inter Arganaty et Keyssyk-auss, 3.5.1857, *P.P. Semenov* (LE!; iso: P!: foto MSB!). The lectotypification by PODLECH 1998 with the type in P is superfluous because the type is indicated in Fl. USSR 1946 as to be in LE.

A. macrourus Hohen. subsp. ***pseudotauricola*** ('*pseudotauricolus*') Ponert, Feddes Repert. 83: 620. 1973. – **Lectotype** (designated here): [Turkey] Prov. Antalya, Elmali, 9.6.1860, *Bourgeau* (sub *A. tauricolus*) (E!: foto MSB; iso: W!). The author cites only the data of the type collection but gives no reference, where the type is housed. A. lectotypification is therefore necessary.

A. monozyx Bornm. 1908, Mitth. Thüring. Bot. Vereins, n.s. 23: 18. – **Lectotype** (designated here): [Iran] Hamadan in montibus Wafs, 10.6.1905, *Th. Strauss* (B!; iso: B!, LE!).

A. oreades C.A.Mey. 1831, Verz. Pfl. Cauc.: 141. – **Lectotype** (Podlech & Sytin, designated here): in regione alpina mt. Kasbek, 7200–8600', 27.9.1829, *C.A. Meyer* (LE!; iso: LE!).

A. pullus N.D.Simpson 1913, Notes Roy. Bot. Gard. Edinburgh 8: 125. – **Lectotype** (designated here): [China] Lichiang Range, Yunnan, 10000–10500', vi.1906, *Forrest 2379* (K!; iso: E!, LE!).

A. salatavicus Bunge 1868, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 117 [et l.c. 15(1): 201. 1869]. – **Lectotype** (Flora USSR 1946): [Russia] in alpe Chanakoi-tau Salataviae, i.e. Daghestaniae borealis, 8800', 24.7.1861, *A.P. Owerin* (LE!; iso: G-BOIS!, P!). The lectotypification by PODLECH 1998 with the type in P is superfluous because the type is indicated in Fl. USSR 1946 as to be in LE.

A. semenovii Bunge 1866, Bull. Soc. Imp. Naturalistes Moscou 39(2): 22. – **Lectotype** (Flora USSR 1946): in der Nähe von Mai-tübe [in valle Ili], 11.5.1857, *P.P. Semenov* (LE!; iso: P!). The lectotypification by PODLECH 1998 with the type in P is superfluous because the type is indicated in Fl. USSR 1946 as to be in LE.

A. semibilocularis Bunge 1868, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 103 in clave [et l.c. 15(1): 183. 1869]. Syntypes: Altai, *Ledebour, Meyer, Bunge et alii.* [Riddersk, *Bunge* (LE!)]. – **Lectotype**: Riddersk (LE!). The lectotypification by PODLECH 1998 with the type in P (hb. Bunge: Fl. orient. Altaica 1839, *A. von Bunge*: with flower dissection) is

superfluous because the type is indicated in Fl. USSR as to come from Ridders and to be in LE.

A. sesbanoides Benth. 1835, in Royle, Illustr. Bot. Himal. Mount.: 199. – **Lectotype** (designated here): Mussooree, *J.F. Royle* (LIV!; iso: K!, LIV!).

A. sungpanensis E.Peter 1938, Acta Horti Gothob. 12: 34. – **Lectotype** (designated here): China, Szechuan, Sungpan, 6.7.1922, *H. Smith 2238* (W!; iso: LD!, PE!).

A. thionanthus Bornm. 1906, Beih. Bot. Centralbl. 19(2): 243. Syntypes: Luristan, in monte Schuturunkuh, vi.1899, *Th. Strauss*; inter Sultanabad et Kum in districtu Chaladschistan, v.1899, *Th. Strauss* (B!, JE!). – **Lectotype** (designated here): Luristan, in monte Schuturunkuh, vi.1899, *Strauss* (JE!; iso: B!).

A. tschujensis Bunge 1868, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 22 in clave [et l.c. 15(1): 24. 1869]. – **Lectotype** (Flora USSR 1946): in lapidosis alpinis ad Tschujam, *A. Politov* (LE!; iso: G!, LE!, MSB!, P!). The lectotypification by PODLECH 1998 with the type in P is superfluous because the type is indicated in Fl. USSR 1946 as to be in LE.

A. tumbatsicus C.Marquand & Airy Shaw 1929, J. Linn. Soc., Bot. 48: 171. – **Lectotype** (here designated): SE. Tibet, Tumbatse, 3400 m, 5.8.1924, *F.F. Kingdon Ward 6057* (K!; iso: E!).

A. umbellatus Bunge 1868, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 24 in clave [et l.c. 15(1): 29. 1869]. – **Lectotype** (Flora USSR 1946): [Russia] insula Nowaja-Semlia ad sinum Kostin-schar, 11.8.1837, *A. Lehmann* (LE!; iso: P!). The lectotypification by PODLECH 1998 with the type in P is superfluous because the type is indicated in Fl. USSR 1946 as to be in LE.

A. variegatus Franch. var. ***koksuensis*** Popov 1928, Trudy Sredne-Aziatsk. Gosud. Univ., ser. 8b, Bot. 3: 38. – **Lectotype** (designated here): Tianschan occid., ad cacumina montis Tschimgan minoris, 4.7.1926, *M. Popov & A.I. Vvedensky* in Herb. Fl. As. Med. *373* (LE!; iso: B!, BR!, BRNU!, E!, K!; LE!, MA!, MSB!, MW).

A. xanthomeloides Korovin & Popov 1928, Trudy Sredne-Aziatsk. Gosud. Univ., Ser. 8b, Bot. 3: 57. – **Lectotype** (designated here): ad cacumina montium Samarkandicorum prope Sazagan, 13.5.1925, *M. Popov* in Herb. Fl. As. Med. *400* (LE!; iso: BRNU!, LE!, MA!, MW, PR!, TASH).

A. xipholobus Popov 1928, Trudy Sredne-Aziatsk. Gosud Univ., Ser. 8b, Bot. 3: 39. – **Lectotype** (designated here): Tian-schan occ., prope stat. Sary-agatsch, 28.5.1928, *Granitov* in Herb. Fl. As. Med. *374* (LE!; iso: B!, BP!, BRNU!, E!, K!, LE!, MA!, MW, P!, PR!, W!).

IX. Some new species in genus *Astragalus*:

Astragalus behbehanensis Podlech, spec. nov. (Sect. *Caprini*).

Holotypus: Iran, Kuhzestan, Behbehan, 400 m, 3.3.1972, *H. Foroughi 3278* (MSB; iso: HUJ).

Differt ab *A. akhanii* Podlech rhachide pilis ad 3 mm longis (nec 0,3–1 mm longis) obtecto, foliis 11–15-jugis (nec 7–9-jugis), foliolis 6–8 × 4–6 (nec 10–22 × 8–17) mm, apice late rotundatis (nec acutiusculis vel breviter acuminati-mucronulatis), supra glabris (nex laxe pilosis), subtus densiuscule pilis oblique patentibus ad 2,5 mm longis obtectis, racemis 7–10 (nec 2–3)-floris, pedicellis 3–4 (nec 5–8) mm longis, calyce 13–14 (nec ca. 17) mm longo,

pilis longioribus obtecto, dentibus 2,5–3 (nec 4–6) mm longis. Lamina alarum auricula 2,5–3 (nec ca. 1) mm longa provisa.

Plants acaulescent, ca. 20 cm tall, with white hairs up to 3 mm long. Caudex up to 8 mm thick, at the apex shortly branched. Stipules whitish-membranous, oblong, 10–15 mm long, the lower ones obtuse, the upper ones acute, adnate to the petiole for 2–5 mm, ciliate at the margins with spreading hairs 0.8–1.5 mm long and very sparsely furnished with minute subsessile glands, otherwise glabrous. Leaves 12–20 cm long; petiole 2–6 cm long, like the rhachis striate-sulcate, loosely covered with ± spreading hairs 1.5–2.5(–3) mm long. Leaflets in 11–15 pairs, elliptic to widely elliptic, 6–8 × 4–6 mm, at the apex widely rounded to slightly emarginate, on upper side glabrous, on underside and at the margins loosely to rather densely covered with ascending hairs 1.8–2.5 mm long. Peduncles 5–8 cm long, hairy like the rhachis. Racemes 7–10-flowered. Bracts whitish-hyalinee, 6–9 mm longe, very narrowly triangular, long hairy. Pedicels 3–4 mm long, spreadingly hairy. Calyx 13–14 mm long, tubular, at the base slightly gibbous, slighty obliquely truncate at the mouth, straw-colored, rather densely covered with very thin, tangled, spreading hairs 1.5–2 mm long; teeth unequal, the upper two from triangular base attenuate, ca. 2.5 mm long, the lower three narrowly triangular, ca. 3 mm long, all densely hairy on innerside. Petals yellow. Standard 22–23 mm long; blade slightly recurved, obovate, 9–11 mm wide, at the apex emarginate, at the base subangularly narrowed into the rather short claw. Wings 21–23 mm long; blade narrowly oblong, rounded at the apex, 9–10 × 3 mm; auricle 2.5–3 mm long, claw 12–14 mm long. Keel 20-22 mm long; blade obliquely elliptic-curved, with widely and nearly rectangular-curved lower edge and distinctly concave upper edge, at the apex obtuse, 8 × 4 mm: auricle ca. 1 mm long, claw 11–13 mm long. Staminal tube very oblique at the mouth. Ovary with a stipe 1–2 mm long, narrowly elliptic, white-hairy; style glabrous. Legumens unknown.

Remark: This new species clearly belongs to the *A. caprinus*-group (see PODLECH 1988) because of the long spreading hairs and the long auricles of wing blades. It is somewhat isolated here by the leaflets glabrous on upper side and by the rather short calyx teeth.

Astragalus bozakmanii Podlech, spec. nov. (Sect. *Caprini*).

Holotypus: Türkei, Prov. Ankara, zwischen Kizilcahamam und Çeltikçi Yolu, 6.6.1970, *I. Bozakman & K. Fitz 906* (W).

Differt ab *A. multijugo* DC. indumento e pilis ad 3 mm (nec 0,2–0,5(–1) mm) longis consistente, stipulis a petiolo fere liberis (nec per 4–5 mm adnatis), foliis ca. 15-jugis (nec 20–30-jugis), foliolis utrinque subappresse (nec oblique patenter ad patenter) pilosis, pedunculis 2–4 cm (nec 7–17 cm) longis, bracteis 5–9 (nec 2–4) mm longis.

Plants ca. 15 cm tall, subacaulescent, covered with spreading, white to reddish hairs up to 3 mm long. Caudex slender. Stems up to 3 cm long, sparsely hairy. Stipules whitish-membranous, 10–12 mm long, narrowly triangular, nearly free from the petiole, sparsely to loosely hairy. Leaves 15–20 cm long; petiole 4–6 cm long, like the rhachis striate-sulcate, rather

densely covered with fine, spreading hairs 1–3 mm long. Leaflets in ca. 15 pairs (in first leaves in ca. 10 pairs), elliptic, 10–13(–18) × 5–6(–8) mm, at the apex minutely acuminate-mucronulate, on both sides loosely to rather densely covered with subappressed hairs up to 2 mm long. Peduncles 2–4 cm long, hairy like the rhachis. Racemes loosely 15–20-flowered. Bracts whitish, narrowly ovate to narrowly triangular, 5–9 mm long, loosely hairy. Pedicels 3–5 mm long, spreadingly hairy. Calyx 12–13 mm long, tubular, slightly obliquely gibbous at the base, slightly obliquely cut at the mouth, loosely to rather densely covered with fine spreading hairs up to 3 mm long; teeth 5–6 mm, unequal, the upper two from triangular base attenuate, the lower three narrowly triangular, all densely hairy on innerside. Petals glabrous, yellow, the standard slightly reddish-suffused. Standard 18–20 mm long; blade ca. 9 mm wide, obovate, slightly emarginate at the apex, at the base gradually narrowed into the cuneate claw. Wings 17–19 mm long; blades narrowly oblong, rounded at the apex, 9–10 × 3 mm; auricle ca. 1 mm long, claw 7–9 mm long. Keel ca. 15 mm long; blades obliquely triangular, with widely, nearly rectangular-curved lower edge and slightly curved upper edge, acutish at the apex, 6 × 4 mm; auricle very short, claw 9 mm long. Staminal tube oblique at the mouth. Ovary wit a stipe ca. 2 mm long, densely hairy; style hairy up to the middle, below the stigma with a dorsal line of short spreading hairlets. Legumes unknown.

Astragalus spitzenbergeri Podlech, spec. nov. (Sect. *Caprini*).

Holotypus: Türkei, Prov. Antalya, Kuhu Dag S von Elmali, Gebiet von Çiglikara, 16.6. 1969, *K. Fitz & F. Spitzenberger 875* (W).

Differt ab *A. antalyensis* Podlech planta sparse pilosa (nec glaberrima), stipulis per 1–2 (nec 3–7) mm petiolo adnatis, foliis 18–22 (nec 7–15)-jugis, calyce 12–13 (nec 10) mm longo dentibus 5–7 (nec 2–3) mm longis, leguminibus semibilocularibus (nec fere complete bilocularibus, pilis tenuibus 2–3 mm long obtectis (nec glabris).

Plants 20–30 cm tall, subacaulescent, sparsely covered with white spreading hairs. Caudex strongly divided, with many short, subterranean branches. Stems up to 6 cm long, angular-sulcate, glabrous. Stipules whitish-membranous, 9–12 mm long, narrowly triangular, adnate to the petiole for 1–2 mm, ciliate at the margins with hairs 0.5–1 mm long, otherwise glabrous. Leaves 12–30 cm long; petiole 4–10 cm long, like the rhachis sparsely to loosely furnished with spreading hairs 1–1.5 mm long. Leaflets in 18–22 pairs, narrowly elliptic to elliptic, obtuse or more rarely acutish at the apex, 6–15 × 3–6 mm, glabrous on upper side or with few scattered hairs only, at the margins and on underside especially at the midvein sparsely to loosely furnished with subappressed hairs up to 1 mm long. Peduncles 0.5–1.5 cm long, glabrous. Racemes loosely 5–9-flowered, several at the base of leaves, sometimes forming a dense , globular head up to 6 cm in diameter in fruit. Bracts whitish, narrowly triangular to linear-acute, 5–7 mm long, sparsely hairy. Pedicels 6–10 mm long, often flexuose. Calyx shortly tubular, 12–13 mm long, sparsely hairy, especially toward the teeth; teeth subulate, 5–7 mm long. Petals yellow. Standard 20 mm long; blades slightly recurved, elliptic to obovate, ca. 10 mm wide, slightly retuse at the apex, at the base gradually narrowed into the cuneate claw. Wings 18 mm long; blades narrowly oblong, rounded at the apex, 9–10 × 3 mm;

auricle ca. 1 mm long, claw 9 mm long. Keel 15 mm long; blades obliquely elliptic, with widely rectangular-curved lower edge and slightly curved upper edge, acute at the apex, 5.5 × 4 mm; auricle short, claw 9 mm long. Staminal tube slightly oblique at the mouth. Ovary subsessile, elliptic, densely hairy; style below the stigma with a line of short spreading hairlets. Pods subsessile, elliptic to obliquely elliptic seen from the side, 10–15 mm long, 5–6 mm high and 2.5–3 mm wide, strongly carinate ventrally, slightly grooved dorsally, subabrurptly attenuate at the apex into a beak 2–3 mm long, semibilocular; valves straw-colored, thin, rather densely covered with very fine, ascending to spreading hairs 2–3 mm long. Seeds ca. 5 in each locule, 3.5–4 × 2–2.5 mm, brown.

Astragalus tecti-mundi Freyn subsp. ***orientalis*** Podlech, subsp. nov. (sect. *Cenantrum*).
Holotype: Pakistan, Hunza- und Nagar-Gebiet, Daintar, 3300–3900 m, 1959, *F. Lobbichler 115* (M; iso: MSB).

Differt a subsp. *tecti-mundi* foliis 5–7-jugis (nec 4–5-jugis), foliolis minoribus, subtus sparse ad laxe appresse ad subappresse pilosis (nec glabris vel subglabris).

Other specimens seen:
Pakistan. Gilgit: Tal NE von Chalt, 3270 m, 27.7.1989, *Bosshard, Klötzli & Schaffner 053.10* (MSB) – Gilgit, 1880, *Tanner 148* (K) – Karakorum, Shinghai Gah to Pahot Gali, 35°48–55 N, 74°10–17' E, 3840 m, 31.7.1990, *G. & S.Miehe 1302* (MSB) – Hunza- und Nagar-Gebiet, Baltar, 4200 m, *Lobbichler 575* (M) – Gharesa Glacier 12 miles E of Nagar, 3890 m, 14.8.1960, *Polunin 6239* (E). – Baltistan: Tibet, Balti, 17.7.1856, *Schlagintweit cat. 6077* (M) – Shagarthang Valley, 3360 m, 18.7.1892, *Duthie 12109* (E) – Ahane Rama, Astor Distr., 3360 m, 5.7.1946, *R.R. Stewart 22906* (K).
India. Kashmir: Ladak, Tsukse, 3960 m, 26.7.1931, *Koelz 2453* (E, W) – Rungdum, 4 km NW of Zuildo, 4130 m, 1980, *Southampton University 145* (K) – Khardang La above Leh, *Heyde* (K) – Zanskar, NW of the Pensi-la, 3650–4270 m, *Stolitzka* (K) – Suru-Siriwang, Ladak side, really Zans-kar, 1.9.1912, *R.R. Stewart 290* (K). – Himachal Pradesh: Lahul, Rangcha Galli, 4420 m, 8.7. 1941, *Bor 14018* (E, K) – Kulu-Lahaul, near Pasparag, 6.7.1888, *Drummond 23484* (E, K).
China. Xinjiang: Distr. Taxkorgan, 2.7.1978, *Xinjian Exped. 1160* (WUK). – Xizang: SE. Tibet, Gyamda Chu, NE tributary, Pasum Tso NE, 4700–4800 m, 30°03' N, 93°59' E, 31.8.1994, *Miehe & Wündisch 94-250-2* (MSB) – Tibetan Himalaya, Everest E, Kama Chu, N bank of upper Kangchung Gl., 5130 m, 28°59' N, 87°03' E, 14.10.1989, *Dickoré 6383* (Hb. Dickoré).

Astragalus poluninii Podlech, spec. nov. (sect. *Chlorostachys*).
Holotypus: Nepal, Gum, near Rara, 7.000 ft, 27.8.1952, *O. Polunin, W.R. Sykes & L.H.J. Williams 3049* (E!).

Differt ab *A. chlorostachyde* Lindl. cui similis sparsissime ad sparse pilosus (nec partim laxe ad densiuscule vel ipse dense pilosus), bracteis 1,5–3 (nec 3–8) mm longis, caducissimis, vexillo 15–16 mm (nec 10–13 mm) longo.

Plants more than 40 cm tall (basal parts missing), very sparsely to sparsely furnished with ± appressed hairs 0.3–0.5 mm long. Stem more than 40 cm long, angular-sulcate, in middle part 3–4 mm in diameter, erect, glabrous. Stipules green, 3–6 mm long, narrowly triangular, free, sparsely black and white ciliate, at the base and the base of petiole with minute, sessile

glands. Leaves 6–20 cm long; petiole 1–2.5 cm long, like the rhachis dinstinctly grooved on upper side, sparsely hairy or with scattered hairs only. Leaflets in 9–13 pairs, narrowly elliptic, 8–20 × 3–7 mm, acute to shortly acuminate at the apex, on upper side glabrous or with few scattered hairs only, on underside sparsely white hairy. Peduncles several in one stem, in the axils of the middle and upper leaves, 6–10 cm long, striate, glabrous or subglabrous. Racemes 4–11 cm long, loosely many-flowered, later on elongating and up to 25 cm long. Bracts falling at the beginning of anthesis, greenish to whitish-membranous, narrowly triangular, 1.5–3 mm long, black and white ciliate with hairs up to 1 mm long, near the base with few minute sessile glands. Pedicels at the beginning of anthesis 1–2 mm long, sparsely hairy, in fruit up to 5 mm long. Bracteoles absent. Calyx campanulate, 6–7 mm long, at the base slighly oblique, slightly obliquely cut at the mouth, subglabrous or sparsely black hairy, at the upper margin and teeth sparsely ciliate; teeth unequal, the lower three subulate, 1–1.5 mm long, the upper two remote, triangular, 0.4–0.5 mm long. Petals pale yellow, with age or dry sometimes pink-suffused. Standard 15–16 mm long; blade elliptic, 6–7 mm wide, emarginate at the apex, gradually narrowed at the base into the rather long claw. Wings ca. 15 mm long; blades narrowly oblong, rounded at the apex, ca. 7 × 2 mm; auricle ca. 2 mm long, claw ca. 8 mm long. Keel ca. 14 mm long; blades obliquely elliptic-triangular, with in the middle widely curved lower edge and ± straight upper edge, obtuse at the apex, ca. 6 × 3 mm; auricle 0.5–1 mm long, claw ca. 8 mm long. Staminal tube oblique at the mouth. Ovary on a stipe 5–7 mm long, glabrous; stigma glabrous. Legumes (immature) on a stipe 8–10 mm long, narrowly elliptic to oblong, 15–17 mm long, ca. 6–7 mm high and wide, at the apex subabruptly narrowed into the straight beak 3–4 mm long; valves thin, pale yellowish, glabrous.

Astragalus rhododendrophila Podlech & L.R.Xu, spec. nov. (sect. *Chlorostachys*).

Holotypus: China, Xizang, S. Tibet, N of Lhünze, Subansiri tributary, Xezar W of Sangngagqoiling, 4070 m, 28°36' N, 92°32' E, *Betula-Rhododendron*-forest, 27.7.1994, *G. Miehe & U. Wündisch 94-107-7* (MSB!).

Differt ab *A. tumbatsico* C.Marquand & Airy Shaw caulibus in parte basali densiuscule pilis albis confuse patentibus ad 1,5 mm longis instructis (nec glabris vel pilis nigris brevibus appressis tantum instructis), foliolis 10–14 (nec 7–9)-jugis, bracteis albi-membranaceis, anguste triangularibus, 3 mm longis (nec viridibus late ovatis, 4–7 mm longis), lamina carinae distincte majore, 7 × 3,5 (nec 4 × 2,5) mm, leguminibus dense praecipue nigri-pilosis (nec glabris).

Plants 50–60 cm tall. Stem 45–52 cm long, 1–3 mm in diameter, hollow, striate, in lower parts rather densely covered with tangled, spreading, white hairs 0.5–1 mm long and with few appressed black hairs 0.3–0.4 mm long, more rarely partly glabrescent and with age also completely glabrous, in upper parts sparsely to loosely covered with short appressed black hairs 0.3–0.5 mm long. Stipules greenish, narrowly triangular, 5–9 mm long, free from the petiole and from each other, sparsely black and white hairy. Leaves 5–8 cm long, subsessile; rhachis slender, loosely furnished with subappressed to ascending, predominantly black hairs 0.1–0.3 mm long. Leaflets in 10–14 pairs, of thin texture, narrowly elliptic, rounded at the apex, 5–13 × 1–3.5 mm, on upper side glabrous, on underside loosely, in the youth more

densely covered with appressed white hairs 0.3–0.5 mm long. Peduncles 6–8 cm long, angular-sulcate, hairy like the upper part of stem. Racemes 4–6 cm long, loosely many-flowerd; axis hairy like the peduncle, flowers ± spreading. Bracts whitish-membranous, narrowly triangular, ca. 3 mm long, black hairy, at the margins with minute, sessile glands. Pedicels 3–5 mm long, densely black hairy. Calyx campanulate, 4–5 mm long, strongly obliquely gibbous at the base, obliquely cut at the mouth, loosely to rather densely covered with subappressed black hairs 0.3–0.6 mm long and sometimes also with a few somewhat longer white hairs; teeth slightly unequal, the three abaxial near together, narrowly triangular, ca. 1.5 mm long, the two adaxial remote, triangular, ca. 1 mm long, all densely black hairy on inner side. Petals cream (?), sometimes flushed with violet, all of nearly the same length. Standard ca. 13 mm long; blade ca. 5 mm wide, elliptic, with slightly distinct short tongue-like, widely emarginate apex, below the middle slightly constricted and narrowed into the widely cuneate claw. Wings ca. 12 mm long; blades narrowly oblong, obtuse at the apex, 7 × 2 mm; auricle ca. 2 mm long, claw ca. 5 mm long. Keel ca. 12 mm long; blades obliquely obovate, with widely curved lower edge and slightly concave upper edge, obtuse at the apex, 7 × 3.5 mm; auricle ca. 1 mm long, claw ca. 6 mm long. Staminal tube ± truncate at the mouth. Ovary on a slender stipe ca. 5 mm long, spindle like, densely white hairy; style and stigma glabrous. Legumes (immature) with a slender stipe ca. 5 mm long, densely covered with ascending white and predominantly black hairs.

Astragalus owirensis [Ali ex] Podlech, spec. nov. (sect. *Cystium*).

Holotype: Pakistan, Chitral, Owir (Nichagh), 11.000 ft, 36°7' N, 71°55' E, 11.6.1958, *S.A. Bowes Lyon 874* (BM!; iso: L!).

Differt ab *A. skorniakovii* B.Fedtsch. foliis brevibus, 3–4 cm longis (nec 5–20 cm longis) 4–6-jugis (nec 10–20-jugis), pedunculis brevibus, calyce saltem partim pilis arcte asymmetrice medifixis oblique patentibus ad patentibus nigris vel griseis obtecto (nec pilis appressis nigris albisque, ± symmetrice medifixis) obtecto, petalis dilute flavis violacei-suffusis (nec violaceis) vexillo obovato apice breviter lingulatim angustato.

Plants 10–30 cm tall, acaulescent or nearly so, covered in vegetative parts with ± appressed to subappressed, mostly ± symmetrically medifixed, white hairs. Caudex up to 10 mm in diameter, slightly to strongly divided, with short branches, covered with remnants of old leaves. Stems, if present, up to 1 cm long, hairy, hidden by the dense stipules. Stipules whitish-hyaline to membranous, 5–8 mm long, adnate to the petiole for 3–4 mm, connate behind the stem up to 1/3 to 1/2 of the length, the free tips often greenish, triangular in the lower stipules, narrowly triangular to subulate-acuminate in the upper ones, glabrous or with few asymmetrically medifixed to basifixed hairs at the margins, especially toward the tips. Leaves 3–4 cm long; petiole 1–2 cm long, like the rhachis rather densely covered with appressed to subappressed, often somewhat flexuose hairs 0.8–1 mm long. Leaflets in 4–6 pairs, narrowly ovate to narrowly obovate, acute to shortly acuminate at the apex. 5–9 × 1.5–4 mm, on both sides loosely to rather densely covered with appressed hairs 0.8–1.5 mm long. Peduncles 2.5–4.5 cm long, angular-sulcate, sparsely to loosely hairy like the rhachis but in upper part often with mixed black and white hairs. Raceme ovoid, 2.5–4 cm long, rather densely few to many-flowered; axis with black hairs. Bracts whitish-membranous, ovate to narrowly triangular, 4–5 mm long, sparsely to loosely black hairy, at the margins also with

basifixed hairs. Pedicels 3–4 mm long, densely covered with tangled, ascending black hairs. Calyx 11–13 mm long, tubular to slightly inflated, scarcely oblique at the base, strongly obliquely cut at the mouth, rather densely covered with strongly asymmetrically medifixed, appressed to ascending, partly even spreading black or black and greyish hairs 0.5–1 mm long; teeth narrowly triangular to linear-acute, 2.5–4 mm long, on innerside black hairy. Petals pale yellow, tinged with violet. Standard 21 mm long; blade 9 mm wide, obovate, at the apex shortly but distinctly tongue-like narrowed, widely retuse, at the base gradually cuneately narrowed. Wings 18 mm long; blades narrowly oblong, shortly narrowed toward the obtuse apex, 7.5 × 2.5 mm; auricle ca. 1 mm long, claw 10–11 mm long. Keel 16 mm long; blades obliquely elliptic with widely rounded lower edge and ± straight upper edge, obtusish at the apex, 7 × 3.5 mm. Staminal tube truncate at the mouth. Ovary with a stipe 1.5–2 mm long, linear, glabrous. Legumes unknown.

The type collection was first named *A. owirensis* by Ali but later on he thought it to be identical with *A. skorniakovii* B.Fedtsch. The description of the latter species in Fl. Pakistan 100 (Papilionaceae) fits well the description of that species in Fl. USSR but not that of the cited specimen. This is in fact a new species described here.

Astragalus argentocalyx [Ali ex] Podlech, spec. nov. (sect. *Dissitiflori*).
Holotype: Pakistan, Chitral, Yarkhun, bezween 36°30' N, 72°40' E and 36°48' N, 73°05' E, 3050 m, 19.6.1958, *S.A. Bowes Lyon 965* (BM).

Differt ab *A. urgutinus* Lipsky foliis 4–5 (nec 6–10) cm longis; foliolis ca. 5-jugis (nec 5–9-jugis), linearibus 10–17 × 1.5–2 (nec 7–10 × 1.5–3) mm, complicatis (nec planis); racemis tantum 5–7-floribus (nec multi-floribus), axi eorum pilis ± symmetrice medifixis subappressis albis 0.4–0.5 mm longis et pilis basifixis, patentibus albis et praecipue nigris ca. 1(–1.5) mm longis obtecto (nec pilis symmetrice ad asymmetrice bifurcatis ascendentibus nigris 0.3–0.4 mm longis et pilis basifixis albis tantum ad 1 mm longis obtecto); bracteis ovatis (nec anguste triangularibus), densissime villosis pilis basifixis praecipue nigris obtectis (nec densiuscule pilis partim asymmetrice medifixis albis nigrisque obtectis); calycis tubo late cylindraceo ad leviter ventricoso (nec cylindraceo), densiuscule pilis asymmetrice medifixis ad basifixis subappressis ad fere patentibus nigris 0.3–0.5 mm longis et densiuscule ad dense pilis basifixis, ascendentibus albis 1.5–2 mm longis obtecto (nec pilis nigis subappressis et albis tantum ad 1 mm longis obtecto); petalis flavi-brunnescentibus (nec albi-violaceis); petalis longioribus; ovario dense pilis albis oblique patentibus ad 1.5 mm longis obtecto.

Plants suffrutescent, ca. 40 cm tall. Caudex with a pluricipital root-crown. Stems several, branched, parts of the current year 9–12 cm long, densely to very densely covered with ± symmetrically medifixed, appressed white hairs 0.4–0.7 mm long, with some black hairs mixed in. Stipules narrowly triangular, 3–4 mm long, shortly adnate to the petiole, with appressed white and black hairs. Leaves 4–5 cm long, those of the lateral branches mostly distinctly shorter, all subsessile or with petiole up to 0.8 cm long; rhachis slender, hairy like the stem. Leaflets in ca. 5 pairs (on leaves of side-branches often only in 3 pairs), linear, 10–17 × 1.5–2 mm, at the apex acute, on upper side loosely, on underside densely covered

with appressed white hairs 1–1.2 mm long, folded. Peduncles 9–12 cm long, rather densely to densely appressed hairy like the stem, below the raceme with increasing black hairs. Racemes 3–4 cm long, loosely 5–7 -flowered, scarcely elongating in fruit; axis covered with ± symmetrically medifixed, subappressed white hairs 0.4–0.5 mm long and with basifixed, spreading white and predominantly black hairs up to 1(–1.5) mm long. Bracts 3–4 mm long, ovate, very densely villous, with basifixed, ascending to spreading, predominantly black hairs ca. 1 mm long. Pedicels 1–2 mm long, white and black hairy; flowers subhorizontally spreading. Calyx widely tubular to slightly ventricous, 13–15 mm long, gibbous at the base, obliquely cut at the mouth, rather densely covered with asymmetrically to strongly asymmetrically medifixed or basifixed subappressed to ± spreading black hairs 0.3–0.7 mm long and rather densely to densely with basifixed, tanglex ascending white hairs 1.5–2 mm long; teeth narrowly triangular, 2–3 mm long, hairy on inner side, at the base densely white, at the apex predominantly black hairy. Petals buff yellow. Standard ca. 24 mm long; blade obovate, ca. 8 mm long, slightly emarginate at the apex, at the base slightly angularly passing into the rather long, narrowly cuneate claw. Wings ca. 24 mm long, as long as the standard; blades narrowly obovate, contricted above the auricle, rounded at the apex, 9–9.5 × 3.5 mm; auricle ca. 0.5 mm long, claw 14–15 mm long. Keel 20–21 mm long; blades obliquely elliptic, with widely curved lower edge and nearly straight upper edge, subacute at the apex, 7.5 × 4 mm; auricle minute, claw ca. 13 mm long. Staminal tube truncate at the mouth. Ovary sessile, fusiform, densely covered with ascending white hairs up to 1.5 mm long; style glabrous. Legumes unknown.

Remark: The type of this species was recognized by Ali as a new species but later on he has changed his mind according to the determination by A. Borissova who named it *A. urgutinus* Lipsky. In spite of some superficial resemblance it is a species distinct from the latter which is endemic in the western Zeravshan and Turkestan Ranges.

Astragalus bingoellensis Podlech, spec. nov. (§ *Dissitiflori*).

Holotype: Turkey, Prov. Mus, [B8] Buglan Geçidi (pass) E Solhan, between Bingöl and Mus, 1640 m, 17.7.1983, *M. Nydegger 18265* (MSB; isotype: BASBG).

Plantae 35 cm altae, dense pilosae. Stipulae membranaceae, 4–8 mm longae, petiolo adnatae. Folia 5–10 juga, foliolis ellipticis 7–18 × 2,5–7 mm, laxe ad densiuscule pilosis. Pedunculus ca. 13 cm longus, pilosus. Racemus ca. 20 cm longus, laxe multiflorus. Bracteae membranaceae, 2,5–3 mm longae, praecipue nigri-pilosae. Pedicelli 2–2,5 mm longi. Calyx 7–8 mm longus, campanulati-tubulosus, pilis asymmetrice medifixis appressis obtectus, dentibus 2–2,5 mm longis. Vexillum 15–17 mm longum et ca. 6 mm latum. Alae ca. 10 mm longae. Legumina sessiles, oblique elliptica, leviter curvata, dense pilis ascendentibus arcte asymmetrice medifixis obtecta.

Plants 35 cm tall, caulescent, densely hairy. Stem ca. 10 cm long, branched, angular-sulcate, very densely covered with symmetrically to asymmetrically, often somewhat flexuose, appressed to subapressed white hairs ca. 1 mm long. Stipules membranous, 4–8 mm long, adnate to the petiole for 1–4 mm, narrowly triangular to nearly subulate, rather densely

covered with symmetrically to strongly asymmetrically medifixed white, near the apex also with some black hairs. Leaves 9–13 cm long; petiole 3–4 cm long, like the rhachis grooved on upper side, loosely to densely hairy like the stem. Leaflets in 5–10 pairs, ± elliptic, 7–18 × 2.5–7 mm, at the apex shortly acuminate, loosely to rather densely covered with ± symmetrically medifixed, appressed white hairs 0.8–1 mm long. Peduncle 13 cm long, angular-sulcate, loosely white hairy like the stem, towards the raceme with increasing, distinctly shorter black hairs. Raceme ca. 20 cm long, loosely many-flowered; axis hairy like upper part of peduncle. Bracts membranous, narrowly triangular, 2.5–3 mm long, with predominantly black hairs. Pedicels 2–2.5 mm long, white and black hairy, flowers erect. Bracteoles none. Calyx 7–8 mm long, campanulate-tubular, slightly obliquely cut at the mouth, rather densely covered with asymmetrically medifixed, often flexuose, appressed to subappressed white hairs 1–1.2 mm long and with sometimes shorter black hairs; teeth subulate, 2–2.5 mm long, densely white hairy on innerside. Corolla violet fading to yellowish-brown or yellowish fading to violet. Standard 15–17 mm long; blade ca. 6 mm wide, elliptic, rounded at the apex, subabruptly narrowed into the short, cuneate claw. Wings ca. 10 mm long; blades narrowly oblong, obtuse at the apex, 6 × 2 mm; auricle 0.8 mm long, claw ca. 5 mm long. Keel ca. 9 mm long, blades obliquely oblong, with in the middle slightly curved lower edge and slightly sigmoid-concave upper edge, acutish at the apex, 4.5 × 2 mm; auricle ca. 0.3 mm long, claw ca. 4 mm long. Staminal tube truncate at the mouth. Ovary sessile, elliptic, white hairy; style glabrous. Legumes (unripe) sessile, obliquely elliptic, slightly curved, with strongly curved dorsal side and slightly concave ventral side, ca. 10 mm long, 3 mm high, attenuate at the apex into a beak ca. 3 mm long; valves densely covered with strongly asymmetrically medifixed, ascending white hairs 1–1.2 mm long.

Astragalus doabensis Podlech, spec. nov. (sect. *Dissitiflori*).

Holotype: North Afghanistan, Doab [Doabe Mekhe Zarin], 5700', 30.4.1937, *R. Meinertzhagen* (BM!).

Plantae ca. 30 cm altae, pilis symmetrice medifixis appressis obtecta. Stipulae 4–6 mm longae. Folia 5–12 cm longa. Foliola 5–6-juga, remota, elliptica. 9–17 × 3–8 mm, supra laxe subtus densiore pilosa. Racemus pedunculo ca. 18 cm longo albi-piloso suffultus, laxe 5–6-florus. Bracteae 2,5–3 mm longae. Pedicelli 2 mm longi. Calyx 18–20 mm longus, tubulosus, pilis albis nigrisque 0,4–1 mm longis obtectus, dentibus 3–4 mm longis. Vexillum 25 mm longum, 8 mm latum, longe unguiculatum. Alae 25 mm longae, lamina 6 × 2 mm. Carina 21 mm longa. Ovarium breviter stipitatum lineare, albi-pilosum. Legumina ignota.

Plant 30 cm tall, covered with ± appressed, mostly symmetrically medifixed hairs. Caudex branched. Stems few, erect, 10–12 cm long, densely covered with white hairs 0.9–1 mm long. Stipules greenish, narrowly triangular, 4–6 mm long, shortly adnate to the petiole, loosely to rather densely white and black hairy. Leaves 5–12 cm long; petiole 2–4 cm long, like the rhachis densely hairy like the stem. Leaflets in 5–6 pairs, remote, elliptic, 9–17 × 3–8 mm, acuminate at both ends, on upper side loosely, on underside loosely to rather densely covered with white hairs 0.6–1.2 mm long. Peduncle ca. 18 cm long, erect, loosely to rather densely white hairy. Raceme short, loosely 5–6-flowered. Bracts whitish, narrowly triangular or from ovate base acuminate, 2.5–3 mm long, white and black or predominantly black hairy. Pedicels

2 mm long, white and black hairy. Calyx 18–20 mm long, tubular, obliquely gibbous at the base, obliquely cut at the mouth, densely covered with appressed to subappressed, ± symmetrically medifixed white and black hairs 0.4–1 mm long; teeth subulate, 3–4 mm long, on innerside densely covered with very thin white hairs. Petals color unknown. Standard ca. 25 mm long; blade widely elliptic, ca. 8 mm wide, emarginate at the apex, at the base gradually narrowed into the long claw. Wings 25 mm long; blades narrowly oblong, rounded at the apex, 6 × 2 mm; auricle short, claw 19 mm long. Keel 21 mm long; blades obliquely elliptic, with widely curved lower edge and nearly straight upper edge, obtuse at the apex, 6 × 3 mm; auricle short, claw 15 mm long. Staminal tube truncate at the mouth. Ovary with a stipe ca. 1.5 mm long, linear, white hairy; style glabrous. Legumes unknown.

Astragalus fruticulosus Podlech, spec. nov. (sect. *Dissitiflori*).

Holotype: Afghanistan, Prov. Badghis, 8 km E Qades, 1380 m, Lössboden, 63°30' E, 34°48' N, 4.5.1977, *D. Podlech & Kh. Jarmal 29825* (MSB!).

Affinis *A. xyloclado* Rech.f. & Gilli, sed differt stipulis 1,5–2,5 mm tantum (nec 4–5 mm) longis, foliolis in caule principali 4–5 (nec 7–8)-jugis, supra laxe pilosis (nec marginem versus tantum pilosis), lamina alarum late elliptica, 5 × 4,5 mm (nec anguste oblonga, 6–7 × 2 mm).

Plants fruticulose, 8–18 cm tall, in vegetative parts covered with appressed to subappressed white hairs, the stipules also with black hairs. Caudex diffusely branched. Stems several, prostrate to erect, branched, with numerous non-flowering, short brachyblasts, the older parts with greyish-brown bark, stems of the current year 2–15 cm long, very densely covered with ± symmetrically medifixed, appressed white hairs 0.3–0.6 mm long. Stipules greenish, triangular, 1.5–2.5 mm long, shortly adnate to the petiole, rather densely white and black or sometimes predominantly black hairy. Leaves of the main stems 2–3.5 cm long; petiole 0.5–0.8 cm long, like the rhachis narrowly grooved on upper side, rather densely to densely white hairy like the stem; leaves of the brachyblasts shorter, nearly sesssile. Leaflets in 4–5 pairs, narrowly elliptic, 3–8 × 1–2.2 mm, those of brachyblast leaves smaller, all rounded or obtuse at the apex, on upper side loosely, on underside densely covered with appressed white hairs 0.6–1 mm long. Peduncle singular in lower part of the stem, 1.5–5 cm long, at fruiting time up to 10 cm long, rather densely hairy like the stem, but toward the raceme also with black hairs. Raceme at anthesis short, densely 4–10-flowered, at fruiting time strongly elongated and 4–6 cm long; axis densely covered with spreading, mostly basifixed hairs white hairs 0.3–1 mm long and with few medifixed to basifixed, ± appressed to ascending, shorter black hairs. Bracts whitish-membranous, 1.5–2 mm long, ovate, covered with ± spreading, mostly basifixed white and black or predominantly black hairs. Pedicels 0.5–1 mm long, white and black hairy. Calyx 11–14 mm long, tubular, slightly gibbous at the base, nearly straightly cut at the mouth, densely villous, with thin, tousled, spreading, basifixed white hairs 1–1.5 mm long and with ascending to ± spreading, basifixed to asymmetrically bifurcate, distinctly shorter black hairs; teeth linear-acute to narrowly triangular, 1–2 mm long, densely white hairy on innerside. Petals yellowish.. Standard ca. 20 mm long; blade obovate, ca. 7 mm wide, rounded to scarcely retuse at the apex, at the base long cuneately narrowed. Wings ca. 20 mm long; blades widely elliptic, rounded at the apex, 6 × 4.5 mm; auricle ca. 1 mm long, claw 13–14 mm long. Keel ca. 17 mm long; blades obliquely

elliptic with in the middle widely and nearly rectangular-curved lower edge and straight to slightly concave upper edge, acute at the apex, 6 × 3 mm; auricle minute, claw ca. 13 mm long. Staminal tube truncate at the mouth. Ovary sessile, linear, hairy; style glabrous. Legumes (unripe) sesssile, linear, strongly falcate, ca. 40 mm long, 1 mm in diameter; valves densely covered with appressed, symmetrically to strongly asymmetrically medifixed white and a few black hairs mixed in up to 1 mm long.

Astragalus lanzhouensis Podlech & L.-R.Xu, spec. nov. (sect. *Dissitiflori*).

Holotypus: China, Prov. Gansu, Lanzhou, 1600 m, 12.6.1996, *Lang-Ran Xu 96-005* (MSB; iso: WUK).

Differt ab *A. stenoceras* stipulis 3–4 (nec 1,5–2) mm longis, alte connati-vaginantibus (nec inter se liberis), foliis 8–12-jugis (nec 4–7-jugis), bracteis 3–4 (nec 1–1,5) mm longis, calyce 11–12 (nec 8–10) mm longo, dentibus subulatis 4–5 mm longis (nec anguste triangularibus, 1–1,5 mm longis), vexillo ca. 16 mm (nec 20–22 mm) longo, leguminibus curvatis, 17–20 mm longis, mere albi-pilosis (nec rectis, 20–35 mm longis, albi-nigri-pilosis).

Plants 10–25 cm tall, with ± symmetrically medifixed, appressed to subappressed hairs. Stems branched near to the base, 7– 20 cm long, angular-sulcate, rather densely to densely covered with appressed white hairs, at the nodes sometimes also with a few black hairs, 0.6–1 mm long. Stipules whitish-membranous, triangular, 3–4 mm long, free from the petiole, behind the stem high up connate, with white and sometimes a few black hairs. Leaves 2–5 cm long; petiole 0.5–1 cm long, like the rhachis slender, loosely to rather densely white hairy as stem. Leaflets in 8–12 pairs, narrowly elliptic, acute at the apex, 7–15 × 1–3 mm, covered on both sides loosely or more rarely rather densely with white hairs 0.8–1 mm long. Peduncles 2.5–8.5 cm long, angular-sulcate, loosely hairy like as stem, below the raceme sometimes with a few black hairs. Raceme at fruiting time 2–4 cm long, loosely 4–8-fruited. Bracts whitish-membranous, ovate, long acuminate, 3–4 mm long, sparsely white and black hairy, at the margins also with subbasifixed to basifixed hairs. Pedicels ca. 2 mm long, white and black hairy. Calyx 11–12 mm long, tubular, slightly obliquely cut at the mouth, loosely covered with subappressed white and black, but mostly predominantly white hairs ca. 1 mm long; teeth subulate, (3–)4–5 mm long, white hairy on innerside. Standard ca. 16 mm long; blade narrowly elliptic-oblong, ca. 6.5 mm wide, widely emarginate at the apex, at the base shortly and indistinctly narrowed. Wings ca. 14 mm long, blades narrowly oblong, slightly obliquely emarginate at the otherwise rounded apex, ca. 7 × 2 mm; auricle ca. 0.8 mm long, claw ca. 7 mm long. Keel ca. 11 mm long; blades obliquely obovate-triangular, with widely corved lower edge and straight upper edge, acute at the apex, 5 × 2.5 mm; auricle ca. .8 mm long, claw ca. 6 mm long. Staminal tube truncate at the mouth. Legumes obliquely erect or spreading, shortly stipitate, linear, slightly curved, terete, 17–20 mm long, 2–2.4 mm high, ca. 2 mm wide, carinate ventrally, grooved dorsally, at the apex shortly attenuate into a straight slender beak ca. 1 mm long, nearly fully bilocular; valves thin but tough, loosely to rather densely covered with appressed to subappressed, somewhat flexuose white hairs 0.6–0.8 mm long.

Other specimen seen:

China. Prov. Gansu: mountains Beitaschan, N of Lanzhou, 24.6.1957, *M.P. Petrov* (LE).

Astragalus montis-karkasii Podlech, spec. nov. (sect. *Dissitiflori*).

Holotype: Iran, Prov. Esfahan, Kuh-e Karkas (Kuh-i-Kargiz), 33°27' N, 51°48' E, in declivibus supra Tar, 2300–2500 m, 27.5.1974, *K.H. Rechinger 46555* (M; iso: W).

Differt ab *A. sitiens* Bunge stipulis vaginati-amplectentibus, truncatis, sine apiculis distinctis, foliis brevioribus, brevissime petiolatis, foliolis pilis 0,5–1 (nec 1–1,5) mm longis obtectis, calyce 6–7 (nec 7–10) mm longo, dentibus triangularibus, ca. 1 mm longis (nec subulatis, 1,5–3 mm longis).

Plants 13–25 cm tall, covered with appressed, ± symmetrically medifixed, white hairs. Caudex divided. Stems several, branched in lower part, the older parts ligneous, short, covered with greyish-brown bark, parts of the current year 3–5 cm long, angular-sulcate, very densely covered with hairs 0.6–1 mm long. Stipules whitish-hyaline, 1.5–3 mm long, adnate to the petiole for ca. 1 mm, behind the stem vaginate-connate, truncate, without distinct free tips, sparsely to loosely hairy. Leaves 2–3 cm long; petiole 0.1–0.6 cm long, together with the short rhachis hairy like the stem. Leaflets in 1–2 pairs, 12–23 × 1.5–2 mm, densely covered on both sides with hairs 0.5–1 mm long. Peduncle 5–7.5 cm long, erect, hairy like the stem. Raceme 5–8 cm long, remotely 5–10-flowered; axis hairy like the peduncle. Bracts membranous, ovate, 1 mm long, sparsely black hairy. Pedicels ca. 3 mm long, erect, densely predominantly shortly black hairy. Calyx 6–7 mm long, turbinate-tubular, not gibbous at the base, obliquely cut at the mouth, rather densely covered with appressed to subappressed black hairs 0.3–0.5 mm long and with mostly fewer, slightly longer white hairs; teeth triangular, ca. 1 mm long, on innerside densely covered with very thin, white, basifixed hairs. Petals pale bluish to pale violet. Standard ca. 16 mm long; blade ca. 6 mm wide, elliptic, emarginate at the apex, with a rather long, narrowly cuneate claw. Wings ca. 14 mm long; blades narrowly oblong, obtuse to slightly obliquely retuse the apex, 7.5 × 2 mm; auricle ca. 1 mm long. claw 7 mm long. Keel ca. 12 mm long; blades obliquely elliptic-curved, with slightly widely curved lower edge and slightly concave upper edge, acutish at the apex, 5 × 2.5 mm; auricle ca. 0.5 mm long, claw 7 mm long. Ovary subsessile, narrowly elliptic, long white hairy; style glabrous. Legumes unknown.

Astragalus pravitzii Podlech, spec. nov. (sect. *Dissitiflori*).

Holotypus: Iran, Prov. Fars: Didegan, in alpe, 2000 m, 16.5.1915, *H. Pravitz 696* (S!).

A. saadatabadensi Podlech ob calycem petalaque brevia similis sed differt stipulis non difformibus, foliolis (1–)2–3(–4) paria (nec 1–3 foliolis tantum), distincte majoribus.

Plants 12–15 cm tall, with ± symmetrically medifixed, appressed, white hairs, at the stipules and in the inflorescense also with black hairs. Caudex divided with short branches, covered with greyish bark. Stems several, ascending to erect, 5–8 cm long, in basal parts densely, in upper parts loosely to rather densely covered with hairs 0.4–0.8(–1) mm long. Stipules slightly greenish, narrowly triangular, 2–2.5 mm long, shortly adnate to the petiole, sparsely to loosely white hairy, sometimes with a few black hairs at the base. Leaves 1.5–3 cm long; petiole 0.5–1.5 cm long, hairy like the stem. Leaflets in (1–)2–3(–4) pairs, elliptic to obovate, 4–9 × 1.5–4 mm, acute to rounded and minutely acuminate at the apex, on both sides rather densely covered with hairs 0.6–1 mm long. Peduncles 4–5 cm long, loosely white hairy

like the stem. Racemes loosely 8–12-flowered; axis hairy like the peduncle. Bracts whitish-membranous, narrowly triangular, ca. 2 mm long, sparsely to loosely covered with partly strongly asymmetrically medifixed, predominantly black hairs. Pedicels 0.5–1 mm long, white hairy. Calyx ca. 7 mm long, tubular, scarcely obliquely gibbous at the base, obliquely cut at the mouth, rather densely to densely covered with appressed white, or white and black hairs 0.6–1 mm long; teeth narrowly triangular, ca. 1 mm long, on innerside nearly glabrous. Petals in dry state yellowish. Standard 14 mm long; blade elliptic, ca. 6 mm wide, slightly emarginate at the apex, at the base cuneately narrowed. Wings 12 mm long; blades narrowly oblong, rounded at the apex, 5 × 2 mm; auricle ca. 1 mm long, claw 7 mm long. Keel 10–11 mm long; blades obliquely obovate, with in upper part widely, nearly rectangular-curved lower edge and slightly concave upper edge, acutish at the apex, 3.5 × 2.2 mm; auricle short, claw 7–8 mm long. Staminal tube truncate at the mouth. Ovary with a stipe ca. 2 mm long, linear, shortly hairy; style glabrous. Legumes (immature) linear, densely covered with appressed white hairs.

Other specimen seen:
Iran. Fars: Abadeh, Nadjaf-abad, 16.5.1962, *Boroumand 12412-E* (IRAN).

Astragalus recurvatus Podlech, spec. nov. (sect. *Dissitiflori*).
Holotype: Persia, Kashan, Mooteh protected region, ad bifurcationem viae publicae versus Muteh (Mooteh) ducentis, c. 140 km NW Esfahan, 1950 m, 30.5.1974, *K.H. Rechinger 46775* (M; iso: W).

Differt ab *A. sitiens* Bunge statura altiore, caulibus pilis brevioribus, 0,2–0,5 mm (nec 0,7–1,1 mm) longis, stipulis longioribus, 6–8 mm (nec 3–4 mm) longis, distincte vaginati-amplectentibus (nec liberis), foliis 4–6 (nec 1–3)-jugis, sparse ad laxe pilosis pilis brevioribus, leguminibus recurvatis ad laterum dorsalem versus, laxe et breviter pilosis.

Plant 50 cm tall, covered with appressed hairs. Caudex slender, with a pluricipital root-crown. Stems few, 22–34 cm long, erect, slightly angular-striate, loosely to densely covered with symmetrically medifixed white hairs 0.2–0.5 mm long. Stipules hyaline-membranous, 6–8 mm long, nearly free from the petiole, behind the stem distinctly to up to the middle vaginate-connate, the free tips narrowly triangular to subulate, sparsely to loosely white hairy, sometimes nearly glabrous. Leaves 4–9 cm long; petiole 1.5–2 cm long, like the rhachis loosely hairy. Leaflets in (3–)4–6 pairs, narrowly linear, 12–20 × 1–1.2 mm, loosely covered on both sides with hairs 0.5–1 mm long. Peduncle 4–11 cm long, erect, angular-striate, loosely hairy like the stem. Raceme remotely 10–15-flowered, at fruiting time elongated and up to 17 cm long; axis white hairy like the peduncle but also with a few black hairs mixed in. Bracts whitish-membranous, narrowly triangular, ca. 3 mm long, sparsely to loosely white and black hairy. Pedicels (at fruiting time) 2–3 mm long, white and black hairy. Calyx whitish-membranous, 7–8.5 mm long, tubular, scarcely obliquely gibbous at the base, slightly obliquely cut at the mouth, loosely to rather densely covered with ± appressed white hairs up to 1.2 mm long and with black hairs 0.3–1 mm long; teeth subulate, 2–3 mm long, mostly curved, on innerside covered with very thin hairs. Petals color unknown. Standard ca. 20 mm long; blade ca. 7 mm wide, elliptic, emarginate at the apex, with a rather long, narrowly cuneate claw. Wings and keel unknown. Staminal tube truncate at the mouth. Legumes sessile, ascending to spreading or even slightly pendulous, narrowly linear, subterete, slightly to

strongly recurved to the dorsal side, 50–60 mm long, ca. 2 mm high and 1.5 mm wide, carinate ventrally, flattish dorsally, at the apex attenuate into a beak 6–10 mm long, incompletely bilocular; valves straw-colored, loosely covered with appressed, ± symmetrically medifixed white hairs 0.2–0.4 mm long, later on partially glabrescent. Seeds ca. 8 in each locule, rectangular, 3 × 1 mm, blackish.

Astragalus saadatabadensis Podlech, spec. nov. (sect. *Dissitiflori*).

Holotypus: Iran, Prov. Fars, Pasagarde, 15 km N of Saadatabad, semidesert, 2000 m, 21.5.1964, *M.L. Grant 15784* (W).

Differt ab *A. argyroide* Beck stipulis difformibus, basalibus quam superiores distincte longioribus et petiolo longe adnatis (nec omnes conformibus), foliis cum 1–3 foliolis tantum (nec (3–)4–6(–7)-jugis, calyce 7–8 (nec 11–13) mm longo, petalis brevioribus, vexillo ca. 14 (nec 18–22) mm longo.

Plants ca. 12 cm tall, with ± symmetrically medifixed, appressed, white, only in the inflorescence also with few black hairs. Caudex with a pluricipital root-crown. Stems several, 3–5 cm long, erect, densely covered with hairs 0.8–1 mm long. Stipules different, the lower ones membranous, 5–7 mm long, at the base wide, adnate to the petiole for 2–3.5 mm, densely covered with somewhat flexuose, partly asymmetrically medifixed hairs 1–1.5 mm long, the free tips up to 4 mm long, narrowly triangular, sparsely to loosely hairy, the upper ones greenish, distinctly shorter, narrowly triangular, adnate to the petiole for 1–2.5 mm, sparsely hairy. Leaves 1–4 cm long; petiole 0.5–2.5 cm long, hairy like the stem. Leaflets 1–3, narrowly elliptic to obovate, 7–10 × 2–4, the end-leaflet mosly larger, 12–16 × 4–6 mm, all acute to shortly acuminate at the apex, on both sides loosely to rather densely covered with hairs 0.8–1.2 mm long. Peduncles 5–7 cm long, loosely hairy like the stem. Racemes loosely 6–8-flowered; axis hairy like the peduncle. Bracts whitish-membranous, narrowly triangular, ca. 2 mm long, sparsely to loosely covered with partly strongly asymmetrically medifixed white or white and black hairs, at the base also with few sesssile, minute glands. Pedicels 1 mm long, white hairy. Calyx 7–8 mm long, tubular, slightly obliquely gibbous at the base, obliquely cut at the mouth, rather densely to densely covered with appressed, white hairs 0.8–1 mm long, at the teeth sometimes also with very few black hairs; teeth narrowly triangular, 1–1.5 mm long, on innerside nearly glabrous. Petals in dry state yellowish, slightly flushed with pink. Standard 14 mm long; blade obovate, ca. 7 mm wide, slightly emarginate at the apex, at the base cuneately narrowed. Wings 11 mm long; blades narrowly obovate, rounded at the apex, 5 × 2 mm; auricle ca. 0.5 mm long, claw 6 mm long. Keel 10 mm long; blades obliquely obovate, with in upper part widely, nearly rectangular-curved lower edge and slightly concave upper edge, obtuse to acutish at the apex, 4 × 2 mm; auricle short, claw 6 mm long. Staminal tube truncate at the mouth. Ovary with a stipe ca. 1 mm long, linear, shortly hairy; style glabrous. Legumes unknown.

Astragalus sata-kandaoensis Podlech, spec. nov. (sect. *Dissitiflori*).

Holotype: Afghanistan, Prov. Paktia, 9–20 km SE Gardez versus jugum Sata Kandao, 2300 m, 3.6.1967, *K.H. Rechinger 35430* (MSB!; iso: W!).

Differt ab *A. xyloclado* Rech.f. & Gilli stipulis 1,5–2 mm (nec 4–5 mm) longis, foliis 2–4-jugis (nec 7–8-jugis), racemis elongatis, remote 3–8 (nec brevibus, dense 7–15-floris), axi racemorum pilis medifixis (nec basifixis) obtecto, calyce pilis ± medifixis, subappressis (nec basifixis, patulis) obtecto, ovario 3–4 mm longe stipitato (nec sessile).

Plants fruticose, 10–20 cm tall, in vegetative parts with ± symmetrically medifixed, appressed to partly subappressed hairs. Caudex up to 10 mm in diameter, strongly branched, covered with grey-brownish bark. Stems several, ascending to erect, branched, with numerous non-flowering, short brachyblasts, the older parts with dark brownish bark, stems of the current year 4–5 cm long, very densely covered with white hairs, near the nodes also with black hairs 0.4–0.8 mm long. Stipules membranous to greenish, triangular, 1.5–2 mm long, very shortly adnate to the petiole, densely white and black or predominantly black hairy. Leaves 1–2 cm long, nearly sesssile; rhachis densely white hairy like the stem, sometimes also with some black hairs. Leaflets in 2–4 pairs, linear or narrowly elliptic, often somewhat recurved, 3–10 × 0.5–1.5(–2) mm, subobtuse to rounded at the apex, often folded, on both sides densely covered with appressed white and sometimes a few black hairs mixed in, 0.8–1.2 mm long. Peduncle 3–6 cm long, white hairy like the stem, in upper part some black hairs. Raceme 2–7 cm long, remotely 3–8-flowered; axis covered with ± medifixed, predominantly white hairs. Bracts whitish-membranous, ca. 2 mm long, ovate-triangular, predominantly black hairy, at the margins with subbasifixed to basifixed hairs. Pedicels ca. 2 mm long, densely predominantly black hairy. Calyx 9–11 mm long, tubular, strongly obliquely gibbous at the base, obliquely cut at the mouth, densely covered with somewhat tousled, subappressed to slightly ascending, ± medifixed white and black hairs up to 1.5 mm long; teeth narrowly triangular-acuminate, ca. 2 mm long, on inner side densely covered with very thin, white hairs. Petals purplish-violet, fading to pale yellowish. Standard 20 mm long; blade obovate, 9–10 mm wide, slightly to distinctly emarginate at the apex, at the base cuneately narrowed. Wings 18–19 mm long; blades narrowly oblong, rounded at the apex, 9–10 × 3–4 mm; auricle 1–1.2 mm long, claw 10 mm long. Keel 16–17 mm long; blades obliquely obovate, with widely curved lower edge and straight to slightly concave upper edge, obtuse at the apex, 8–9 × 3.5–4 mm; auricle ca. 1 mm long, claw 9 mm long. Staminal tube truncate at the mouth. Ovary on a stipe 3–4 mm long, linear, hairy; style glabrous.

Other specimens seen:

Afghanistan. Bamian: hill on west side of Shibar pass, 3000 m, 14.6.1962, *Hedge & Wendelbo W.4198* (BG). – Parwan: Shibar-Pass, nahe der Passhöhe, 2900 m, 27.6.1967, *Freitag 1201* (MSB) – east side of Shibar pass, c. 2800 m, 14.6.1962, *Hedge & Wendelbo W.4247* (BG).

Astragalus wakhanicus Podlech, spec. nov. (*Dissitiflori*).

Holotype: Afghanistan, Prov. Badakhshan, Wakhan, oberes Baroghil Tal und Baroghil Pass, 73°22' E, 36°53' N, 3300–3800 m, 30.7.1971, *O. Anders 7905* (MSB!; iso: S!).

Differt ab *A. viridis* Bunge stipulis brevibus, 1,5–3 (nec 5–7) mm longis, foliis 4–5 (nec 5–9)-jugis, foliolis apice acuto, rubri-brunneo, breviter cartilaginei-cucullato, axi racemi pilis

brevibus appressis albis nigrisque obtecto (nec pilis oblique patentibus ad patentibus albis, 0,3–1,2 mm longis obtecto), bracteis 2–3 (nec 4–6) mm longis, leguminibus pilis longissimis ad 1,5 mm (nec ad 3) mm longis obtectis.

Plants suffruticose, 30–35 cm tall, vegetative parts covered with ± symmetrically medifixed, appressed hairs. Caudex branched. Stems at the base ligneous, covered with dark greyish bark, branched, stems of the current year 6–17 cm long, very densely covered with white, near the nodes also with a few black hairs 0.5–0.7 mm long. Stipules narrowly triangular, 1.5–3 mm long, adnate to the petiole for 0.5–1.5 mm, white hairy, those of upper leaves sometimes also with black hairs. Leaves 4–7 cm long; petiole 0.3–0.5 cm long, like the rhachis slender, densely hairy like the stem. Leaflets in 4–5 pairs, linear to filiform, 10–20 × 0.8–1 mm, at the apex acute, with a short, reddish-brown, cartilaginous, cucullate tip, on both sides densely covered with white hairs 0.8–1 mm long. Peduncles 11–16 cm long, loosely to rather densely white hairy like the stem, toward the raceme also with some black hairs, sometimes partly glabrescent. Racemes (in fruiting state) loosely 4–12-flowered; axis subappressed hairy like the peduncle but with mixed black and white hairs. Bracts narrowly triangular to ovate-acuminate, 2–3 mm long, white and black hairy, at the margins also with basifixed hairs. Pedicels (in fruit) ca. 3 mm long, with ascending white and black hairs. Calyx ca. 15 mm long, tubular, rather densely covered with subappressed, ± symmetrically to asymmetrically medifixed black hairs 0.3–0.7 mm long and with ascending, strongly asymmetrically medifixed to subbasifixed white hairs 1–1.5 mm long; teeth subulate, 3–3.5 mm long, densely white hairy on innerside. Petals unknown. Staminal tube truncate at the mouth. Legumes sessile, erect, oblong, ca. 20 mm long, 4–5 mm high and wide, carinate ventrally, slightly grooved dorsally, at the apex subabruptly attenuate into a beak 2–3 mm long, fully bilocular; valves thinly coriaceous, brownish to blackish when ripe, densely villous with ascending to spreading, basifixed white hairs 1–1.5 mm long and with short, asymmetrically medifixed, subappressed black hairs, at the dorsal side also with ascending, subbasifixed black hairs up to 1 mm long.

Astragalus sherriffii Podlech, spec. nov. (Sect. *Hemiphaca*).

Holotype: India, Kashmir, Gya. Ladah, 13.500 ft, 14.7.1941, *F. Ludlow & G. Sherriff 8491* (E).

Differt ab *A. lhorongensis* P.C.Li & C.C.Ni stipulis inferioribus post tergum caulis distincte vaginanti-connatis nec omnibus inter se liberis), foliis 3–4 (nec 4–10) cm longis, 4–5 (nec 5–7)-jugis, lamina alarum apice retusa ad emarginata (nec rotundata).

Plants ca. 25 cm tall, covered with appressed to subappressed hairs 0.2–0.3 mm long. Caudex up to 10 mm thick, with a pluricipital root-crown. Stems several, ascending to erect, very sparsely to sparsely furnished with white and some black hairs especially below the nodes. Stipules greenish, the lower ones ca. 3 mm long, ovate, free from petiole, distinctly vaginate-connate behind the stem, the upper ones narrowly triangular, up to 4 mm long, free from each other, all loosely white or white and black hairy. Leaves 3–4 cm long; petiole 0.8–2 cm long, like the rhachis slender, sparsely to loosely hairy like the stem. Leaflets in 4–5 pairs, linear, 7–12 × 1.5–3 mm, obtuse at the apex, on upper side glabrous, on underside sparsely to loosely appressed white hairy. Peduncles 3–7 cm long, sparsely to loosely, toward the raceme more densely hairy like the stem. Racemes 2–3 cm long, loosely many-flowered. Bracts

whitish-membranous, narrowly triangular, 1–1.5 mm long, predominantly black hairy. Pedicels ca. 0.5 mm long, predominantly black hairy; flowers ± spreading. Calyx campanulate, ca. 3 mm long, obliquely cut at the mouth, rather densely covered with predominantly black hairs; teeth unequal, the upper two triangular, 0.5–1 mm long, the lower three narrowly triangular, 1–1.5 mm long, hairy on innerside. Petals flushed with pink. Standard ca. 7 mm long; blade elliptic to widely elliptic, 4–5 mm wide, incised at the apex, narrowed at the base without a distinct claw. Wings 5.5 mm long; blades narrowly oblong, retuse to emarginate at the apex, 4 × 1.5 mm; auricle 0.5 mm long, claw 2 mm long. Keel 4 mm long; blades obliquely obovate-triangular, with rectangular-curved lower edge and straight to slightly concave upper edge, subobtuse at the apex, 2.5 × 1.5 mm; auricle indistinct, claw 1.5 mm long. Staminal tube truncate at the mouth. Ovary shortly stipitate, glabrous; style thick, short. Legumes unknown.

Astragalus tsangpoensis Podlech & L.R.Xu, spec. nov. (sect. *Hemiphaca*).

Holotypus: China, Xizang, SE. Tibet, Tsangpo valley, c. 5 km W of Gonggar (Lhasa Airport), 29°17' N, 90°49' E, 3620 m, 30.7.1989, *B. Dickoré 3064* (MSB).

Plantae ultra 30 cm altae, pilis albis nigrisque subappressis ad adscendentibus 0,3–0,7 mm longis instructae. Caules ramosi. Stipulae triangulares, 3–5 mm longae, liberae. Folia 3–7 cm longa. Foliola 8–11 juga, 4–9 × 1–2,5 mm, acuta, complicata, supra glabra, subtus laxe ad densiuscule appresse pilosa. Pedunculi 5–6 cm longi, sparse ad laxe pilosi. Racemi 1,5–2,5 cm longi, laxe 6–10-flori. Bracteae 1,5–2 mm logae. Calyx campanulatus, c. 3 mm longus, albi- vel albi-nigri-pilosus, dentibus 1 mm longis. Vexillum c. 7 mm longum, orbiculare, 6 mm latum, brevissime unguiculatum. Alae 6,5 mm longae, lamina apice rotundata, 4,5 × 2,5 mm. Carina c. 5 mm longa. Ovarium sesssile, albi-pilosum. Legumina ignota.

Plants at least 30 cm tall (basal parts missing), covered with subappressed to tangled-ascending hairs 0.3–0.7 mm long. Stem ascending to erect, branched, 2–3 mm in diameter, glabrous in basal parts, sparsely to loosely white and black hairy in upper part. Stipules greenish, 3–5 mm long, triangular, sparsely white and black hairy, free from petiole and from each other. Leaves 3–7 cm long; petiole 0.5– 1.5 cm long, like the rhachis loosely to rather densely covered with white and sometimes with fewer black hairs. Leaflets in 8–11 pairs, narrowly ovate to narrowly elliptic, acute at the apex, 4–9 × 1–2.5 mm, glabrous on upper side, loosely to rather densely subappressed white hairy on underside, mostly folded. Peduncles 5–6 cm long, hairy like the stem. Racemes 1.5–2.5 cm long, loosely 6–10-flowered. Bracts whitish-membranous to slightly greenish, 1.5–2 mm long, narrowly triangular, sparsely white and black hairy, at the margins with few sessile, minute glands. Pedicels 0.5 mm long, black and white hairy. Calyx campanulate, slightly obliquely cut at the mouth, ca. 3 mm long, loosely to rather densely covered with white or white and black hairs; teeth linear, ca. 1 mm long, hairy on inner side. Petals (in dry state) whitish yellow or very slightly flushed pale bluish. Standard ca. 7 mm long; blade orbicular, ca. 6 mm long, widely emarginate at the apex, at the base abruptly constricted into the very short claw. Wings ca. 6.5 mm long; blades elliptic, rounded at the apex, 4.5 × 2.5 mm; auricle ca. 0.5 mm long, claw ca. 2 mm long. Keel ca. 5 mm long; blades obliquely elliptic-triangular, with in the middle widely curved lower edge and slightly convex upper edge, obtusish to acute at the apex, 3.5 × 2 mm; auricle minute, claw ca. 2 mm long. Staminal tube slightly oblique at the mouth. Ovary sessile, ellipsoid, white hairy; style glabrous. Legumes unknown.

Astragalus olurensis Podlech, spec. nov. (sect. *Incani*).

Holotype: Turkey, Prov. Çoruh (Artvin), between Olur and Yusufeli, towards Ishan, 870 m, 25.5.1990, *M. Nydegger 45536* (MSB; isotype: BASBG).

Differt ab *A. latifolio* Lam. statura humiliore, calyce breviore, tubo ejus intus glabro, petalis violaceis distincte brevioribus, forma leguminis diversissima, leguminibus 18–20 mm (nec 40–60–80) mm longis, ca. 4 mm (nec 2,5 mm) altis.

Plants 5–15 cm tall, covered with appressed, mostly symmetrically medifixed, merely white hairs 0.3–0.5 mm long. Caudex up to 10 mm in diameter, unbranched or slightly and shortly branched, covered in upper part with remnants of old leaves. Stipules narrowly triangular, ca. 5 mm long, adnate to the petiole for ca. 2 mm, densely hairy, sometimes glabrescent. Leaves 4–7 cm long; petiole 1.5–4.5 cm long, densely hairy. Leaflets only 1 or 1–6 paired, often with quite different number of leaflets in one plant, ovate to widely elliptic, at the base widely cuneate to truncate, at the apex acute to acuminate or widely rounded, mostly minutely mucronulate, if only one leaflet, this 10–25 × 6–21 mm, if more leaflets, than those 3–7 × 2–5 mm but end-leaflet mostly larger, on both sides loosely to rather densely hairy and mostly spotted with minute reddish dots. Peduncle erect or ascending, 4–9 cm long, loosely to rather densely hairy. Raceme loosely 6–8-flowered. Bracts membranous, narrowly triangular, 1–2.5 mm long, sparsely hairy, at the margins near the base with minute, globular, sesssile glands. Pedicels erect, 1 mm long, white hairy. Bracteoles linear, 0.5–1 mm long, at the base of the calyx. Calyx 11–13 mm long, tubular, obliquely cut at the mouth, loosely to rather densely hairy, inner side of tube glabrous; teeth subulate, 5–6 mm long, on inner side densely hairy. Corolla violett. Standard 17–18 mm long; blade slightly upcurved, 7 mm wide, elliptic, at the apex emarginate, at the base gradually narrowed into the short, cuneate claw. Wings 13–14 mm long; blades narrowly oblong, gibbous above the auricle, at the apex rounded, laterally obliquely slightly emarginate, 7 × 2 mm; auricle 1 mm long, claw 7 mm long. Keel ca. 11 mm long; blades obliquely obovate, with widely curved lower edge and slightly concave upper edge, at the apex subacute, 5 × 2.5 mm; auricle ca. 0.5 mm long, claw 7 mm long. Staminal tube truncate at the mouth. Ovary linear, sessile, white hairy; style glabrous. Legumes sessile, erect linear, slightly to distinctly upcurved, 18–20 mm long, ca. 4 mm high, 3 mm wide, carinate ventrally, slightly grooved dorsally, tapering into a straight beak ca. 3 mm long, bilocular; valves coriaceous, dirty pale brownish, loosely to rather densely hairy.

Astragalus zaraensis Podlech, spec. nov. (sect. *Incani*).

Holotype: Turkey, Prov. Sivas, [B7] N of Karabel, at road from Divrigi to Zara, 1560 m, 18.6.1992, *M. Nydegger 46325* (MSB; isotype: BASBG).

Differt ab *A. ancistrocarpo* Boiss. & Hausskn. calyce breviore, 7–8 (nec 11–14) mm longo, dentibus ejus 0,5–1,5 (nec 2–4 mm longis, petalis distincte brevioribus, vexillo apicem versus non lingulato-angustato, laminis alarum anguste oblongis, ca. 2 mm latis (nec apicem versus distincte dilatatis, 3,8–4 mm latis), leguminibus erectis 16–20 mm longis (nec saepissime pendulis vel patentibus, 20–35–40 mm longis).

Plants acaulescent, ca. 12–16 cm tall, covered in vegetative parts with appressed, symmetrically medifixed white hairs 0.4–0.5 mm long. Caudex simple or shortly branched,

covered with remnants of old leaves. Stipules narrowly triangular to narrowly oblong, 6–8 mm long, adnate to the petiole for 1.5–2 mm, rather densely hairy. Leaves 5–11 cm long; petiole 2–4 cm long, like the rhachis loosely to rather densely hairy. Leaflets in 5–11 pairs, elliptic to obovate, 3–8 × 2–5 mm, at the apex obtuse to retuse, on both sides densely hairy when young, loosely hairy with age, on upper side sometimes spotted with minute pellucid to reddish dots. Peduncle 7–10 cm long, loosely white hairy. Raceme at anthesis rather densely 10–20-flowered, strongly elongating in fruit; axis hairy like the peduncle. Bracts whitish- to brownish-membranous, narrowly triangular, 1.5–3 mm long, sparsely white and black hairy, at the margins with minute, sessile, globular glands. Pedicels ca. 2 mm long, black and white hairy; flowers erect. Bracteoles minute, 0.3– 1 mm long, whitish, at the base of calyx or just below the calyx at the pedicel. Calyx 8–9 mm long, tubular, gibbous at the base, obliquely cut at the mouth, loosely covered with appressed white and black hairs 0.2–0.4 mm long and with somewhat longer white hairs; teeth narrowly triangular to linear, 0.5–1.5 mm long, hairy on inner side. Petals violet. Standard ca. 20–21 mm long; blade distinctly upcurved above the middle, ca. 6–6.5 mm wide, narrowly elliptic, not attenuate towards the slightly retuse apex, subabruptly narrowed at the base into the rather long claw. Wings ca. 15 mm long; blades narrowly oblong, obliquely laterally emarginate at the apex, 7–8 × 2 mm; auricle ca. 1 mm long, claw ca. 8 mm long. Keel 13 mm long; blades obliquely obovate, with widely curved lower edge and sigmoid-concave upper edge, at the apex obtuse to subacute, 5 × 2.5 mm; auricle 0.5 mm long, obtuse, claw ca. 7 mm long. Staminal tube truncate at the mouth. Ovary subsessile, linear, sparsely appressed hairy; style glabrous. Legume sessile, erect, linear, distinctly upcurved to sickle-shaped, 16–20 mm long, ca. 2 mm high and 2.5 mm wide, slightly carinate ventrally, narrowly grooved dorsally, attenuate at the apex into a slender, ± straight beak 3–4 mm long, fully bilocular; valves thinly coriaceous, pale brownish, distinctly purplish mottled, loosely covered with appressed white hairs 0.5–0.6 mm long, sometimes glabrescent.

Other specimen seen:
Turkey. Sivas: [B6] Bestepeler Geçidi at road from Kayseri to Sivas, 1400 m, 12.6.1992, *Nydegger 46236* (MSB).

Astragalus damxungensis Podlech & L.R.Xu, spec. nov. (sect. *Komaroviella*).
Holotype: China, Prov. Xizang, Nyaingentanglha Shan, between Yangbajain and Damxung, valley SE of Nyaingentanglha Feng, 5060 m, 30°19' N, 90°35' E, 12.8.1989, *B. Dickoré 3887* (MSB).

Plantae fere acaules, humiles, 3–4 cm altae, subglabrae, pilis perpaucis nigris 0,2–0,3 mm longis instructae. Stipula 3–4 mm longae, a petiolo liberae, inter se distincte vaginanti-connatae. Folia 4–6 juga, foliolis 3–5 × 1–2,8 mm. Racemi pedunculo 0,5–1 cm longo suffulti, 1–2-flori. Calyx campanulatus, ca. 6 mm longus, dentibus 2,5–3 mm longis. Petala purpurei-violacea. Vexillum 12–13 mm longum, lamina ca. 10 mm latum, suborbiculare. Alae 10 mm longae. Carina 11 mm longa. Legumina ignota.

Plants 3–4 cm tall, nearly acaulescent, in vegetative parts subglabrous, with few sub-appressed, black hairs 0.2–0.3 mm long. Caudex with short stolones. Stems inconspicuous, glabrous. Stipules greenish to membranous, 3–4 mm long, narrowly ovate to oblong, with

obtusish tips, nearly free from the petiole, behind the stem distinctly to highly up vaginate-connate, glabrous. Leaves 1.5–2.5 cm long; petiole 0.4–0.7 cm long, like the rhachis glabrous or with scattered hairs. Leaflets in 4–6 pairs, elliptic, 3–5 × 1–2.8 mm, at the apex obtuse to acutish, glabrous or more rarely with scattered hairs on underside, glabrous on upper side, conspicously and densely rugulose when dry on underside. Peduncle 0.5–1 cm long, glabrous or below the raceme with scattered black hairs. Raceme 1–2-flowered. Bracts whitish-membranous, ca. 3 mm long, narrowly ovate, glabrous. Pedicels ca. 2 mm long, rather densely hairy. Bracteoles present, linear-subulate, 1–2 mm long, whitish, sparsely hairy, at the base of calyx. Calyx campanulate, ca. 6 mm long, rather densely hairy; teeth linear, slightly unequal, 2.5–3 mm long, hairy on innerside. Petals purple-violet. Standard 12–13 mm long; blade ca. 10 mm wide, widely obovate-orbicular, at the apex emarginate, at the base gradually narrowed into a short, cuneate claw. Wings ca. 10 mm long; blades narrowly obovate, rounded at the apex, 7 × 3 mm; auricle ca. 1 mm long, claw 3 mm long. Keel 11 mm long; blades obliquely obovate, with in upper part widely curved lower edge and ± straight upper edge, at the apex obtuse, 8 × 4 mm; auricle ca. 0.5 mm long, claw 3.5 mm long. Staminal tube truncate at the mouth. Ovary with a stipe ca. 1.5 mm long, glabrous. Pods unknown.

Astragalus rasmontii Podlech, spec. nov. (sect. *Onobrychoidei*).

Holotype: Turkey, Prov. Sivas, Yazyurdu, 1760 m, 38°48'14'' N, 36°56'07'' E, 11.7. 1995, *P. Rasmont PR105* (MSB!; iso: LG).

Plantae ca. 50 cm altae, pilis bifurcatis albis nigrisque 0,1–0,3 mm longis obtectae. Stipulae 2–4 mm longae, inferiores vaginanti-connatae, superiores inter se liberae. Folia 7–9 cm longa, 10–13 juga, foliolis anguste ellipticis, 6–13 × 1–2,5 mm, supra glabris, subtus sparse ad laxiuscule albi-pilosis. Racemi pedunculo 6–9 cm longo laxiuscule piloso suffulti, 2,5–4,5 cm longi, dense multiflori. Bracteae ovatae, 1,5–2 mm longae. Calyx ca. 4 mm longus, campanulatus, albi-nigri-pilosus, dentibus 1–1,5 mm longis. Petala violacea. Vexillum 14–15 mm longum, 5–6 mm latum, ovatum, apicem versus gradatim angustatum. Alae 9–10 mm longae. Carina 7–7,5 mm longa. Legumina ca. 5 mm longa, bilocularia, pilis albis arcte asymmetrice medifixis ca. 0,5 mm longis obtecta.

Plants ca. 50 cm tall, covered with appressed bifurcate hairs 0.1–0.3 mm long. Stem up to 45 cm long, branched, sparsely white and black hairy, partly glabrescent. Stipules 2–4 mm long, the lower ones membranous, very shortly adnate to the petiole, behind the stem distinctly vaginate-connate, subglabrous, the upper ones often greenish, free from the petiole, mostly clasping the stem partly with a narrow rim but not connate, sparsely hairy at the margins. Leaves 7–9 cm long, subsessile, those of side-branches shorter; rhachis sparsely to loosely white and black hairy. Leaflets in 10–13 pairs, narrowly elliptic, 6–13 × 1–2.5 mm, obtuse at the apex, on upper side glabrous, on underside sparsely to rather loosely white hairy. Peduncles 6–9 cm long, rather loosely white and black hairy. Racemes ovoid to shortly cylindric, 2.5–4.5 cm long, densely many-flowered. Bracts membranous, 1.5–2 mm long, ovate, sparsely hairy. Pedicels ca. 0.5 mm long, predominantly black hairy. Calyx campanulate, ca. 4 mm long, loosely to rather densely covered with black hairs and with somewhat longer white hairs up to 0.5 mm long; teeth narrowly triangular, 1–1.5 mm long, hairy on innerside. Petals deeply violet. Standard 14–15 mm long; blade 5–6 mm wide, ovate, gradually

narrowed toward the minutely emarginate apex, at the base subabruptly narrowed into the claw ca. 3 mm long. Wings 9–10 mm long; blades narrowly oblong, slightly dilated toward the slightly and obliquely retuse apex, ca. 6 × 2.5 mm; auricle ca. 0.6 mm long, claw 3.5–4 mm long. Keel 7–7.5 mm long; blades obliquely elliptic, with in the middle widely curved lower edge and slightly curved upper edge, obtuse at the apex, 3.5 × 2.5 mm; auricle ca. 0.5 mm long, claw 3.5–4 mm long. Staminal tube oblique at the mouth. Ovary subsesssile, ellipsoidic, white hairy; style glabrous. Legumes (immature) subsessile, elliptic, ca. 5 mm long, 2 mm high, compressed laterally, carinate ventrally, grooved dorsally, at the apex with a short oblique beak, nearly completely bilocular; valves thin, rather densely covered with strongly asymmetrically medifixed white hairs ca. 0.5 mm long. Seeds two in each locule, brown.

Astragalus austrotibetanus Podlech & L.R.Xu, spec. nov. (sect. *Polycladus*).

Holotypus: China, Xizang, SE. Tibet, Lhasa valley, c. 30 km SW of Lhasa, 29°26' N, 90°55' E, 3650 m, 30.7.1989, *B. Dickoré 3093* (MSB; iso: hb. Dickoré).

A. leucocephalo Benth. similis sed differt pilis albis nigrisque (nec mere albis) instructus, caulibus pilis subappressis ad leviter ascendentibus (nec patentibus) obtectis, racemis oblongis, demum elongatis et laxiusculis (nec globosis ad ovoideis, densis), bracteis 3–4 (nec 5–6) mm longis, petalis caerulei-violaceis (nec pallide flavis), vexillo latiore, leguminibus curvatis (nec rectis).

Plants up to 30 cm tall, in vegetative parts covered with subappressed to ascending, often flexuous, tangled white hairs 0.5–1.5 mm long. Caudex up to 8 mm thick, branched. Stems several, erect or at the base slightly ascending, sometimes branched, 10–20 cm long, angular-sulcate, loosely to rather densely hairy. Stipules green, narrowly triangular, 6–9 mm long, free from petiole, the lower ones behind the stem distinctly connate, the upper ones free from each other, loosely hairy. Leaves 4–8 cm long, nearly sessile; petiole up to 1 cm long, like the rhachis grooved on upper side, loosely to rather densely hairy. Leaflets in 12–15 pairs, elliptic, acute to obtuse, 5–14 × 1.5–7 mm, on upper side glabrous or subglabrous to sparsely hairy, on underside loosely to rather densely hairy. Peduncles 1–3 in the axils of upper leaves, 2–7 cm long, hairy like the stem but mostly also with black hairs toward the raceme. Racemes shortly cylindric, 2–5 cm long, rather loosely many-flowered, later on slightly elongated. Bracts membraneous, narrowly triangular, 3–4 mm long, predominantly white but also black hairy, at the margins with few minute glands. Pedicels ca. 1 mm long, predominantly white hairy, recurved, flowers therefore pendant. Calyx campanulate, 4–5 mm long, slightly obliquely cut at the mouth, rather densely covered with subsppressed to ascending white hairs 0.5–1 mm long and with mostly somewhat shorter black hairs; teeth slightly unequal, narrowly triangular, 1.5–3(–3.5) mm long, hairy also on inner side. Petals blue-violet or more rarely white. Standard 7–8(–9) mm long; blade widely elliptic to suborbicular, 5–6(–7) mm wide, at the apex slightly to deeply emarginate, at the base shortly gradually narrowed without distinct claw. Wings 5.5–7(–9) mm long; blades narrowly elliptic, obtuse at the apex, 4–4.5(–6) × 2–2.5 mm; auricle ca. 0.5 mm long, claw 1.5–2.5(–3.5) mm long. Keel 5–6(–7) mm long; blades obliquely elliptic-triangular, with in the middle ± rectangular-curved lower edge and slightly curved upper edge, obtuse at the apex, 3–3.5(–4) × 2–2.5 mm; auricle minute, claw 2–3 mm. Staminal tube oblique at the mouth. Ovary subsessile, elliptic, hairy; style

short, glabrous. Pods subsessile, obliquely elliptic, curved, ca. 6–7 mm long, 2–2.5 mm high and wide, carinate ventrally, flattened to shallowly grooved dorsally, narrowed toward the acute apex, often with persistent, hooked style, unilocular; valves rather densely covered with ascending white or white and black hairs up to 0.8 mm long. Seeds two, 3 × 1.5 mm, blackish.

Other specimens seen:

China. Qinghai: NE. Tibet, along Golmud - Lhasa highway, NE of Tanggulashanqu, 4580 m, 34°18' N, 92°34' E, 4.8.1993, *G. & S. Miehe 9413/15* (MSB, Hb. Miehe). – Xizang: Dochen Lake, c. 4600 m, 24.6.1939, *Gould 2192* (K) – Tingri, 4580–4890 m, 4.7.1974, *Hingston 201, 213* (K) – Rama, 4870 m, 29.6.1939, *Gould 2209* (K) – Samoda, 4280 m, 9.8.1936, *Chapman 507* (K) – Nalu La to Champitang, 3660–4280 m, 1.8.1936, *Chapman 1037* (K) – Gooring valley, 90°25' E, 30°12' N, 5050 m, vii.-viii.1895, *Littledale* (K) – Gyantse, 4020 m, 19.8.1935, *Cutting & Vernay 43* (K) – SE. Tibet, Lhasa valley, Lhasa, W. City, 3660 m, 1.8.1989, *B.Dickoré 3134* (MSB, hb. Dickoré) – Lhasa, 21.5.1943, *Ludlow & Sherriff 9514* (E) – dto., 6.7.1943, *Ludlow & Sherriff 9739* (E) – dto., ix.1904, *Waddell* (E) – Tsangpo Valley, Gonggar (Lhasa Airport), 3620 m, 29°17' N, 90°50' E, 30.7.1989, *Dickoré 3025* (MSB, Hb. Dickoré) – ca. 10 km NNE of Lhasa, 4350 m, 2.8.1989, *Dickoré 3284, 3299* (MSB, hb. Dickoré) – Lhasa valley, c. 30 km SW of Lhasa, 29°26' N, 90°55' E, 3650 m, 30.7.1989, *Dickoré 3093* (MSB) – Lhasa, above Chupsang Monastery, 4300–4400 m, 29°41' N, 91°08' E, 9.8.1997, *Miehe, Huang, Otsu & Tunsu 97-008-15* (MSB, Hb. Miehe) – dto., 4050 m, 13.8.1997, *Miehe, Huang, Otsu & Tunsu 97-014-02* (MSB) – Upper Kyi Chu, above Reting Monastery, 4300 m, 30°18' N, 91°31' E, 22.8.1997, *Miehe, Huang, Otsu & Tunsu 97-027-01* (MSB) – SE Tibet, upper Kyi Chu basin, S of Damxung, 4550 m, 30°33' N, 91°27' E, 7.9.1995, *G. & S. Miehe 95-37-05* (MSB) – Mekong - Salween divide, Salween tributary, Bamda - Nujiang, NE of pass, 4450 m, 30°10' N, 97°17' E, 5.7.1994, *Dickoré 8896* (MSB, Hb. Dickoré) – Mekong - Salween divide, Salween tributary, right flanc of Yü Qu N of Bamda, 4130 m, 30°20' N, 97°15' E, 7.7.1994, *Miehe & Wündisch 94-52-1* (MSB, Hb. Miehe) – Mekong - Salween divide, Mekong tributary, Bamda - Qamdo, Zi Qu tributary SW of Gyitang, 3450 m, 30°42' N, 97°19' E, 7.7.1994, *Dickoré 9012* (MSB, hb. Dickoré) – Upper Gyamda Chu (Nyang Chu), W of Gongbogyamda, 4700–4850 m, 29°52' N, 92°17' E, 2.9.1994, *Miehe & Wündisch 94-256-1* (MSB, Hb. Miehe) – EC. Tibet, Yamco Yumco (Yamdrok Yutsho), above Dzamtschili, 4570 m, 28°59' N, 90°27' E, 5.9.1997, *Miehe, Huang, Otsu & Tunsu 97-057-25* (MSB, Hb. Miehe) – dto., 4450 m, 12.9.1995, *G. & S. Miehe 95-52-05* (MSB) – Yamco Yumco, above Shangding Gompa, 4570 m, 28°58' N, 90°29' E, 4.9.1997, *Miehe, Huang, Otsu & Tunsu 97-054-17* (MSB, Hb. Miehe) – Yamco Yumco, (Yamdrok Yutsho), above Baidi, 4500 m, 29°07' N, 90°26' E, *Miehe, Huang, Otsu & Tunsu 97-063-21* (MSB, hb. Miehe) – Lhasa - Nagarze, Yamdruk Yumco, Zamu E of Nagarze, 4520 m, 28°59' N, 90°32' E, 24.7.1994, *Dickoré 9909* (MSB) – upper Subansiri, Lhünze - Qayü, 15 km NW of Qayü, 3800 m, 28°23' N, 92°42' E, 31.7.1994, *Dickoré 10268* (MSB) – Chayul Dzong, Loro Chu, *Ludlow & Sherriff 1326* (W).

Astragalus cobresiiphila Podlech & L.R.Xu, spec. nov. (sect. *Polycladus*).

Holotypus: China, Xizang, valley ca. 8 km SSE of Lhasa, 3950 m, *B. Dickoré 3384* (MSB; iso: hb. Dickoré).

Differt ab *A. stricto* Benth. foliolis 5–8 (nec 8–12)-jugis, 1–4 mm (nec 4–10 mm) longis, vexillo 6–7 mm (nec 7–9 mm) longo, leguminibus pilis ad 0,2 mm longis (nec 0,3–0,7 mm longis) obtectis.

Plants up to 12 cm tall, caespitose, furnished with appressed to subappressed hairs. Caudex with a pluricipital root-crown. Stems numerous, diffusely prostrate to ascending, up to 5 cm long, slender, angular-sulcate, loosely furnished with appressed, somewhat flattened hairs 0.1–0.2 mm long, partly glabrescent to glabrous, especially in lower part. Stipules

greenish or membranous, 2–3.5 mm long, ovate-triangular, free from the petiole, distinctly connate behind the stem, sparsely hairy to sometimes glabrous. Leaves 1–3.5 cm long; petiole 0.3–1.2 cm long, like the rhachis slender, somewhat flattened, sparsely to loosely hairy like the stem. Leaflets in 5–8(–9) pairs, elliptic, 1–4 × 0.6–2 mm, at the apex rounded to emarginate, on upper side glabrous, on underside especially at the midvein sparsely to loosely covered with appressed hairs up to 0.3 mm long. Peduncles several in upper leaf axils, 1.5–5 cm long, slender, sparsely to loosely hairy like the stem but with increasing black hairs toward the raceme. Racemes short, densely 3–10-flowered. Bracts whitish-membranous, ovate to narrowly triangular, 1–1.5 mm long, white and black hairy at the margins often with short stalked minute glands. Pedicels 0.5–1 mm long, black hairy. Calyx campanulate, (2.5–)3–4 mm long, slightly obliquely cut at the mouth, loosely covered with appressed black hairs 0.1–0.3 mm long and more rarely also with some white hairs; teeth unequal, the lower three narrowly triangular, 0.5–1.5 mm long, the other two triangular, 0.3–1 mm long. Petals blue to purple. Standard 6–7 mm long; blade widely elliptic to orbicular, ca. 5 mm wide, deeply emarginate at the apex, at the base gradually narrowed without distinct claw. Wings ca. 5.5 mm long; blades narrowly elliptic, obtuse at the apex, 3.5 × 1.8–2 mm; auricle 0.5 mm long, claw 2 mm long. Keel 5 mm long; blades obliquely elliptic, with widely curved lower edge and sigmoid upper edge, subacute at the apex, 3 × 1.8–2 mm; auricle minute, claw 2 mm long. Staminal tube slightly oblique at the mouth. Ovary with a stipe ca. 1 mm long, white hairy; style glabrous. Legumes subsessile or with a stipe ca. 1 mm long, pendulous, narrowly elliptic, curved, ca. 6 mm long, 2 mm high and wide, carinate ventrally, grooved dorsally, acute at the apex with the hooked persistent style, unilocular; valves thin, pale brownish, loosely covered with appressed black hairs 0.1–0.2 mm long, soon glabrescent. Seeds 3–4, 2 × 1.2 mm, blackish.

Other specimens seen:

China. Qinghai: Qinghai Nan Shan, S of Qinghai Hu, E of Jiangxigou, 3460 m, 36°33' N, 100°28' E, 26.7.1993, *G. & S. Miehe 9316/28* (MSB, Hb. Miehe) – Qilian Shan, Riyue Shan, Lyewa Pass, SE of Qinghai Hu, 3350 m, 36°25' N, 101°05' E, 26.7.1993, *G. & S. Miehe 9313/10* (MSB, Hb. Miehe) – Tangula Shan N, upper Yangtse basin, Bi Qu, Tangula Pass - Yanshiping, Tangula Station, 4890 m, 33°15' N, 91°51' E, 3.9.1989, *Dickoré 4637* (MSB, Hb. Dickoré) – Tangula Shan N, upper Yangtse basin, Gar Qu, Mt. Geladadong, NE glacier tongue, 5000 m, 33°34' N, 91°27' E, 30.8.1989, *Dickoré 4545* (MSB, Hb. Dickoré). – Xinjiang: Karakorum, Aghil Shan, northern declivity, Aghil valley, ca. 19 km SW of Ylik, 4160 m, 36°15' N, 76°33' E, 30.8.1986, *Dickoré 479* (MSB, Hb. Dickoré) – Aghila Shan, ca. 7 km NW of Aghil Pass, 4200 m, 36°14' N, 76°34' E, 30.8.1986, *Dickoré 486* (MSB, Hb. Dickoré). – Xizang: Upper Tsangpo basin, Ngamring – Sangsang, 4620 m, 29°19' N, 86,53' E, 20.8.1993, *G. & S. Miehe 9518/07* (MSB, Hb. Miehe) – EC. Tibet, Central Plateau, Nagqu - Siling Co, 4620 m, 31°24' N, 90°59' E, 12.8.1993, *G. & S. Miehe 9469/02* (MSB, Hb. Miehe) – Central Plateau, E of Siling Co, 4600 m, 31°42' N, 89°36' E, 13.8.1993, *G. & S. Miehe 9478/06* (MSB, Hb. Miehe) – Lhasa, 3670 m, 21.5.1943, *Ludlow & Sherriff 9515* (E) – dto., 3970 m, 25.6.1943, *Ludlow & Sherriff 9715* (E) – Lhasa, 5200 m, 6.9.1904, *Waddell* (K) – Nyainqentanghla Shan, Yangbajain - Damxung NW. of Lhasa, SE. of Nyainquent, 4900 m, 30°17' N, 90°37' E, 9.8.1989, *Dickoré 3538, 3569* (MSB, hb. Dickoré) – dto., 5060 m, *Dickoré 3786* (MSB, Hb. Dickoré) – 10 km NNE of Lhasa, 4280 m, 29°45' N, 91°09' E, 2.8.1989, *Dickoré 3249* (MSB, Hb. Dickoré) – Nagarze - Lhozak, Pomo Co (C7), 5010 m, 28°30' N, 90°33' E, 18.7.1994, *Miehe & Wündisch 94-76-10* (MSB, Hb. Miehe) – SE Tibet, upper Yi'ong Zangbo, above Lhari, 4530 m, 31°39' N, 93°12' E, 2.9.1995, *G. & S. Miehe 95-07-03* (MSB, Hb. Miehe).

Astragalus conaensis Podlech & L.R.Xu, spec. nov. (Sect. *Polycladus*)

Holotype: China, Xizang, Tibetan Himalaya NE of Bhutan, N of Cona, 28°07' N, 91°54' E, 4720 m, 30.7.1994, *B. Dickoré 10235* (MSB; iso Hb. Dickoré).

Differt ab *A. conferto* cui habitu similis foliolis 3–7 (nec 5–9)-jugis, pedunculis ad 1,5 (nec ad 4) cm long, calyce pilis nigris 0,1–0,3 mm longis et pilis albis 0,6–1 mm longis (nec imprimis pilis nigris 0,1–0,3 mm tantum longis) obtecto, vexillo ca. 9 (nec 10–12) mm longo, lamina carinae 4,5 × 2,5 mm (nec 6–7 × 3 mm).

Plants acaulescent to subacaulescent, densely caespitose, 2–5 cm tall, furnished with subappressed, in vegetative parts white, in inflorescence also black hairs 0.4–0.5 mm long. Caudex up to 10 mm in diameter, repeatedly divided with short thick, subterranean branches. Stems or basal leaf-rosettes numerous, stems if present up to 0.5 cm long, angular-sulcate, loosely hairy. Stipules whitish-membranous, 3–4 mm long, ovate-triangular, free from the petiole or shortly adnate, but distinctly connate before the petiole, behind the stem connate up to the middle, rather densely hairy. Leaves 1–2 cm long; petiole 0.5–0.8 cm long, like the rhachis slender, rather densely hairy. Leaflets in 3–7 pairs, narrowly elliptic to elliptic, 1–3 × 0.5–1.5 mm, obtuse at the apex, on upper side sparsely to loosely, on underside rather densely to densely hairy, often somewhat folded. Peduncles 0.3–1.5 cm long, white and black hairy. Racemes short, 2–5-flowered. Bracts whitish-membranous, narrowly triangular, 1.5–2.5 mm long, predominantly black hairy, at the base often with minute, sessile glands. Pedicels ca. 1 mm long, densely black hairy. Calyx narrowly campanulate, 4–5 mm long, slightly obliquely cut at the mouth, rather densely to densely covered with appressed, black hairs 0.1–0.3 mm long and with subappressed white hairs 0.6–1 mm long; teeth subulate, 2–2.5 mm long, densely hairy on innerside. Petals deeply violet. Standard ca. 9 mm long; blade widely elliptic to suborbicular, ca. 6 mm wide, retuse at the apex, at the base gradually narrowed, without distinct claw. Wings ca. 8 mm long; blades narrowly oblong, apex obtuse to rounded, ca. 5.5 × 1.8–2 mm; auricle ca. 1 mm long, claw 3.5 mm long, slightly curved. Keel ca. 8 mm long; blades obliquely elliptic, with in the middle widely to rectangular-curved lower edge and ± straight to slightly concave upper edge, obtuse at the apex, ca. 4.5 × 2.5 mm; auricle ca. 0.8 mm long, claw ca. 3.5 mm long. Staminal tube slightly oblique at the mouth. Ovary with a slender stipe ca. 1 mm long, narrowly elliptic, white hairy; style glabrous. Legumes unknown.

Other specimen seen:

China. Xizang: Tibetan Himalaya NE of Bhutan, N of Cona, 28°07' N, 91°54' E, 4610 m, 30.7.1994, *G. Miehe & Wündisch 94-123-12* (MSB) – N slope Shisha Pangma [Xixabangma], S. Tibet, 5100–5200 m, 10.9.1984, *Miehe 1515* (BM) – dto., 5530 m, 13.9.1984, *Miehe 1533* (BM) – up from Nyalam, 4300 m, 3.9.1984, *Miehe 1403* (BM).

Astragalus tibeticola Podlech, spec. nov. (sect. *Polycladus*).

Holotype: China, Prov. Xizang: S. Tibet, Chayul Dzong, Loro Chu, 23.4.1936, *F. Ludlow & G. Sherriff 1326* (BM).

Plants 15–25 cm tall. Stems 10–17 cm long, branched at the base, ascending to erect, striate-sulcate, sparsely to loosely covered with appressed to subappressed white, at the nodes also black hairs 0.4–0.7 mm long. Stipules green, 6–9 mm long, ovate-acuminate to

narrowly triangular, free from the petiole, behind the stem high up vaginate-connate, sparsely to loosely covered with appressed white and sometimes also with some black hairs. Leaves 6–12 cm long; petiole 1–3 cm long, like the rhachis loosely covered with appressed white hairs 0.2–0.5 mm long. Leaflets in 9–11 pairs, narrowly elliptic to elliptic, 7–17 × 3–6 mm, rounded to slightly emarginate at the apex, glabrous on upper side, sparsely and mainly at the midrib furnished with appressed white hairs 0.5–1 mm long. Peduncles 5–6 cm long, hairy like the stem but in upper part with predominantly black hairs. Racemes ovoid, rather loosely 7–15-flowered, Bracts whitish, linear-acute, 2.5–3 mm long, predominantly black hairs. Pedicels ca. 1 mm long, black hairy. Calyx campanulate, 4–5 mm long, slightly oblique at the base, slightly obliquely cut at the mouth, rather densely covered with appressed black hairs 0.2–0.3 mm long and with fewer, slightly longer white hairs; teeth subulate, 1.5–2 mm long. Petals mauve with whitish center, keel purplish-mauve. Standard ca. 6 mm long; blade 5 mm wide, transverse-elliptic, deeply incised at the apex, at the base subabruptly contracted into the very short claw. Wings ca. 6 mm long; blades oblong, rounded at the apex, 3.5 × 2 mm; auricle wide, ca. 0.5 mm long, claw 2.5 mm long. Keel 5 mm long; blades oblique-elliptic, rounded at the apex, 3 × 2 mm; claw 2 mm long. Staminal tube truncate et the mouth. Ovary sessile, white-hairy; style glabrous. Legumes unknown.

Astragalus L. sect. ***Pseudotapinodes*** Podlech & L.R.Xu, sect. nov.

Differt ab *A.* sect. *Polyclado* Y.C.Ho stipulis petiolo adnatis et post tergum caulis distincte connatis (nec a petiolo liberis), leguminibus quoad cognatis semibilocularibus (nec unilocularibus).

Typus sectionis: *A. orbicularifolius* P.C.Li & C.C.Ni, Acta Phytotax. Sin. 17: 112. 1979. Holotypus: [China] Chongba, 5500 m, 9.8.1975, *Chinghai-Tibetan Complex Exp. 6724* (PE).

The following species belongs to this section up to now: *A. dickorei* Podlech & L.R.Xu, *A. longiscapus* C.C.Ni & P.C.Li, *A. orbicularifolius* P.C.Li & C.C.Ni.

Astragalus dickoreí Podlech & L.R.Xu, spec. nov. (Sect. *Pseudotapinodes*).

Holotypus: China, Sichuan, Litang to Batang, Jinsha (Jangtse) - Yalong divide, Pass to Litang Plateau E of Yidun, 4800 m, 30°14' N, 99°33' E, 28.6.1994, *B. Dickoré 8532* (MSB).

Differt ab *A. longiscapo* foliis 0,8–1,5 (nec 1,5–9) cm longis, glabris vel subglabris (nec laxe ad densiuscule pilosis), bracteis ellipticis 3–4 mm longis (nec anguste triangularibus 2 mm longis, vexillo ca. 10 (nec 7) mm longo, carina alis multo breviore (nec ca. 1 mm tantum breviore).

Plants acaulescent, 1.5–2 cm tall, subglabrous in vegetative parts. Caudex slender, sometimes branched. Stems absent. Stipules whitish-membraneous, ovate, 3–4 mm long, widely rounded at the apex, adnate to the petiole for 1.5–2 mm, vaginate-connate behind the stem for 1–2 mm, toward the apex and at the margins with tousled, white and black hairs up to 0.3 mm long. Leaves 1–1.5 cm long, glabrous or leaflets with few white hairs up to 0.4 mm long;

petiole 0.4–0.6 mm long. Leaflets in 3–4 pairs, narrowly elliptic, 3–5 × 1–1.5 mm, obtuse at the apex. Peduncles inconspicuous, up to 0.3 cm long, densely covered with subappressed to slightly ascending, tousled black hairs ca. 0.3 mm long. Racemes short, densely 4–5-flowered. Bracts whitish-membranous, 3–4 mm long, elliptic, rather densely hairy like the peduncle. Pedicels 0.5–1 mm long, black hairy. Calyx campanulate, 3–4 mm long, rather densely covered with flexuous, tangled black hairs up to 0.3 mm long; teeth narrowly triangular to oblong, 1.5–2 mm long, black hairy on innerside. Petals blue-violet. Standard ca. 10 mm long, elliptic, ca. 6 mm wide, shortly incised at the apex, at the base subabruptly narrowed into the cuneate claw ca. 2 mm long. Wings ca. 9 mm long; blades narrowly obovate, rounded at the apex, 6–6.5 × 2.5 mm; auricle ca. 0.5 mm long, claw 2–2.5 mm long. Keel ca. 5 mm long; blades obliquely elliptic, with slightly but widely curved lower and upper edge, acutish at the apex, 3.5 × 2.2 mm; auricle short, claw 2 mm long. Staminal tube slightly oblique at the mouth. Ovary sessile, glabrous; style short, thick. Legumes unknown.

X. New names and combinations in *Astragalus*

Astragalus angorensis Podlech, nom. nov. – Typonym: *A. brevidentatus* Podlech, Sendtnera 6: 151. 1999, illeg. [non C.H.Wright 1906]

Astragalus keredjensis Podlech, nom. nov. – Typonym: *Astragalus triqueter* Bornm. & Gauba, Repert. Spec. Nov. Regni Veg. 39: 106. 1935, illeg. [non A.Gray 1878].

Astragalus maowensis Podlech, & L.R.Xu, nom. nov. – Typonym: *Astragalus aridicola* P.C.Li, Acta Bot. Yunnanica 11(3): 295. 1989, illeg. [non Sosn. 1948].

Astragalus obtusifoliolus (S.B.Ho) Podlech & L.-R.Xu, comb. nov.
Basion.: *A. nobilis* B.Fedtsch. var. *obtusifoliolus* S.B.Ho, Bull.Bot. Res. North-East. Forest. Inst. 3(4): 58. 1983. Holotype: [China] Xinjiang, Wuqia Xian, Jigen, Ximuhana, 3000 m, 29.7.1978, *Exped. Xinjiang Inst. Bot. Bor.-Occ. 2128* (WUK: foto MSB!; iso: WUK!)
Figures: Ho, S.B. loc. cit. 67, tab. 6, fig. 1–11; Flora Reipublicae Popularis Sinicae 42(1): 346, tab. 92, fig. 14–23. 1993

This plant has nothing to do with *A. nobilis* because of the spreading hairs at the calyx and the bilocular fruit. It is nearest to *A. sphaerocystis* Bunge. Because the taxon is based on a very short diagnosis only, a complete description is given here.

Plants 7–8 cm cm tall, acaulescent, in vegetative parts covered with ± symmetrically medifixed, appressed white hairs. Caudex divided with very short branches, covered with remnants of old leaves. Stipules whitish-membranous, ca. 5 mm long, adnate to the petiole for 2 3–3.5 mm, densely covered with hairs up to 1 mm long, at the margins also with basifixed hairs, the free tips triangular, glabrous on the innerside. Leaves 2–6 cm long; petiole 1–3 cm long, like the rhachis grooved on upper side, densely covered with hairs 0.5–1 mm long. Leaflets in 2–4 pairs, elliptic to obovate, 4–9 × 2–5 mm, at the apex rounded to very shortly acuminate, on both sides densely hairy like the rhachis. Peduncles 4–5 cm long, rather densely to densely white hairy like the rhachis, in upper part also with few black hairs, often

glabrescent. Racemes shortly ovoid, densely many-flowered. Bracts whitish-membranous, 4–5 mm long, narrowly triangular, with white and black hairs, at the margins with basifixed hairs. Pedicels ca. 1 mm long, white and black hairy. Calyx soon ovoid-inflated, 9–11 mm long, 7–9 mm in diameter, loosely covered with ± spreading, basifixed to subbasifixed white hairs 1–1.5 mm long and with fewer and slightly shorter, ± medifixed, subappressed black hairs, the whole surface finely rugulose-warty; teeth subulate, 1–2 mm long. Petals purple-red (according to the diagnosis). Standard ca. 20 mm long; blade ovate, ca. 7 mm wide, emarginate at the apex, subabruptly constricted in lower third and then gradually narrowed. Wings ca. 18 mm long; blades narrowly oblong, obliquely emarginate at the apex, ca. 9 × 2 mm; auricle 0.5 mm long, claw 9–10 mm long. Keel 13–15 mm long; blades obliquely elliptic, with widely curved lower edge and slightly convex upper edge, acutish at the apex, ca. 5 × 3 mm; auricle minute, claw 8–10 mm long. Staminal tube truncate at the mouth. Ovary sessile, densely appressed hairy; style hairy only at the base. Legumes subsessile, oblong, 6–7 mm long, 3–3.5 mm high and 2 mm wide, carinate ventrally, slightly grooved, at the apex abruptly terminating into a slender, hooked beak ca. 2 mm long with persistent style, bilocular; valves thin, straw-colored, densely covered with subappressed to partly ascending, subbasifixed white hairs 0.5–0.8 mm long.

Astragalus pseudotauricola (Ponert) Podlech, comb. et stat. nov. – Basion.: *A. macrourus* Hohen. subsp. *pseudotauricola* ('*pseudotauricolus*') Ponert, Feddes Repert. 83: 620. 1973.

Astragalus parrisii Podlech, nom. nov. – Typonym: *Astragalus glaberrimus* Podlech, Sendtnera 6: 146. 1999, illeg. [non Sirj. & Rech.f.].

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Prof. Dr. Dietrich Podlech, Institut für Systematische Botanik der Ludwig-Maximilians-Universität München, Menzinger Straße 67, D-80638 München, Germany.

New species of *Astragalus* L. sect. *Hymenostegis* (Fabaceae) from Iran

D. PODLECH & A.A. MAASSOUMI

Abstract:
PODLECH, D. & MAASSOUMI, A.A.: New species of *Astragalus* L. sect. *Hymenostegis* from Iran. – Sendtnera 7: 203–209. 2001. ISSN 0944–0178.

During the work on "Flora Iranica" seven new species of *Astragalus* sect. *Hymenostegis* could be discovered among the rich material collected in recent times. They are described here: *A. anguranensis, A bashmaghensis, A. bradosticus, A. doghrunensis, A. marivanensis, A. pseudopersicus, A. qoturensis.*

Zusammenfassung:
Im Verlauf der Bearbeitung der Gattung *Astragalus* für die „Flora Iranica" konnten sieben neue Arten der Sect. *Hymenostegis* aufgefunden werden, die hier beschrieben werden: *A. anguranensis, A bashmaghensis, A. bradosticus, A. doghrunensis, A. marivanensis, A. pseudopersicus, A. qoturensis.*

Astragalus anguranensis Podlech & Maassoumi, spec. nov.

Holotype: Iran, prov. Zanjan, distr. Mahneshan, Anguran, Belgheis mts., 2800 m, 26.7.1998, *R.R. Maassoumi & V. Mozaffarian 78520* (TARI; iso: MSB).

Differt praecipue et conspicue ab *A. pedicularifórme* Maassoumi pedunculis pilis rectis appressis ad subappressis vel leviter ascendentibus 0,3–1 mm longis (nec dense pilis confuse patentibus ad 0,5 mm longis et paucioribus oblique patentibus ad patentibus 1,5–2,5 mm longis) obtectis.

Plants suffruticose, caespitose, 15–22 cm tall, spiny. Stems 6–15 cm long, the lower parts ligneous, branched, densely covered with blackish remnants of old leaves, parts of the current year1–3 cm long. Stipules membranous-hyaline, 15–20 mm long, adnate to the petiole for ca. 8–10 mm, connate behind the stem for 1.5–4 mm, the free tips narrowly triangular, 8–10 mm long, glabrous or mostly ciliate at the margins with hairs up to 1.5 mm long, in basal parts with somewhat netlike nerves, slightly netlike dissoluting with age. Leaves 3–8 cm long; petiole 1.5–3 cm long, like the rhachis rather densely covered with appressed hairs 0.3–0.7 mm long, sometimes glabrescent. Leaflets in 5–7 pairs, remote, narrowly elliptic, 10–20 × 2–4 mm, at the apex acuminate, pungent, with a cusp 0.5–3 mm long, on both sides in the youth rather densely to densely appressed hairy like the rhachis, with age mostly only sparsely to loosely hairy. Peduncles 2–4 cm long, shorter than the leaves, erect, densely covered with

appressed to slightly ascending straight hairs 0.3–1 mm long. Racemes ovoid to shortly cylindrical, 3.5–7 cm long and 2.5–3 cm in diameter, densely many-flowered. Bracts ± persistent, chartaceous-glumaceous, scarcely hyaline toward the margins, 10–12 mm long and 3–5 mm wide, ovate-acuminate, shortly aristate, glabrous or sparsely ciliate at the margins. Calyx tubular-inflated, 13–15 mm long and 4–5 mm wide, whitish or creamy, in upper part purplish, with purple parallel nerves and teeth, sparsely to rather densely covered with short hairs up to 0.5 mm long and rather densely with mostly ascending or sometimes partly spreading hairs 1–2.5 mm long; teeth ca. 5 mm long. Petals pink to purplish. Standard 17–18 mm long; blade ca. 8 mm wide, obovate-panduriform, rounded at the apex, slightly to distinctly constricted in lower part, at the base acutely hastate-auriculate, with widely cuneate claw. Wings ca.16 mm long; blades narrowly obovate, at the apex rounded, ca. 7 × 3 mm; auricle ca. 0.3 mm long, claw 9–10 mm long. Keel ca. 14 mm long; blades obliquely obovate, with in upper part up to rectangularly curved lower edge and nearly straight upper edge, acutish at the apex, 4–× 2.5 mm; auricle short, claw 9–10 mm long. Ovary ca. 4–5 mm long, narrowly ellipsoidic, densely appressed hairy; style hairy at the base. Legumes unknown.

Other specimens seen:

Iran. Zanjan: ca. 77 km from Mahneshan to Anguran, 2300 m, 24.5.1987, *Maassoumi 64809* (TARI) – on the road to Mahneshan, meck mountain [SE of Mahnestan], 1950 m, 25.7.1998, *Maassoumi & Mozaffarian 78505* (MSB).

Astragalus bashmaghensis Maassoumi & Podlech, spec. nov.

Holotype: Iran, Kordestan, Saqqez, between Sonnate and Divandarreh, Kuh-e Ghaleh, neck mt. between Bashmagh and Jafarabad, 2300 m, 14.7.1991, *V. Mozaffarian 70063* (TARI; iso: MSB!).

Differt ab *A. doghrunense* Maassoumi & Podlech foliis 10–17 (nec 2–6) cm longis, foliolis 10–22 × 3–4 (nec 5-9 × 1,5–3) mm, pedunculis 12–18 (nec 5–8) cm longis, racemis elongatis, 6–10 (nec 3–4) cm longis, bracteis 10–15 × 5–7 (nec 9–10 × 3–5) mm, calyce pilis longioribus 2–3(–4) (nec 1–1,5) mm longis obtecto.

Plants 22–30 cm tall, subacaulescent. Stems up to 7 cm long, the lower parts ligneous, branched, densely covered with blackish remnants of old leaves, part of the current year 1–2 cm long. Stipules hyaline-membranous, whitish, 15–20 mm long, narrowly triangular, adnate to the petiole for 5-8 mm, shortly connate behind the stem, the free tips many-nerved, glabrous, ciliate at the margins with ascending hairs up to 1 mm long. Leaves 2–6 cm long; petiole 3–5 cm long, like the rhachis loosely to rather densely covered with appressed to partly slightly ascending hairs 0.2–0.8 mm long. Leaflets in 6–9 pairs, narrowly elliptic, 10–22 × 3–4 mm, acuminate with a cusp 1–2 mm long, on both sides sparsely to loosely covered with appressed to subappressed hairs 0.3–0.6 mm long. Peduncles 12–18 cm long, up to 3 mm thick, ± as long as the leaves, loosely to densely covered with appressed to subappressed hairs 0.3–1(–1.5) mm long. Racemes cylindric, 6–10 cm long and ca. 2 cm in diameter, densely many-flowered. Bracts chartaceous, not hyaline, yellowish, partly falling, 10–15 mm long, 5–7 mm wide, ovate-acuminate, glabrous, rarely very sparsely shortly ciliate. Calyx pale yellowish, at first tubular-ventricous, soon becoming elliptically inflated, 13–15 mm long,

rather densely covered with short hairs 0.2–0.5 mm long and with ascending hairs 2–3(–4) mm long; teeth subulate, ca. 5 mm long. Petals pale yellow. Standard ca. 17 mm long; blade obovate-panduriform to ovate, ca. 7 mm wide, rounded but minutely mucronulate at the apex, slightly constricted below the middle or not, angular-hastate at the base, with widely cuneate claw. Wings ca. 15 mm long; blades narrowly oblong, rounded at the apex, 6 × 2 mm; auricle ca. 0.3 mm long, claw ca. 10 mm long. Keel ca. 15 mm long; blades obliquely obovate, with in upper part rectangularly curved lower edge and slightly convex upper edge, at the apex subacute, ca. 5 × 2.8 mm; auricle minute, claw 10 mm long. Ovary narrowly ellipsoid, ca.5 mm long, densely appressed hairy; style hairy at the base. Legumes unknown.

Astragalus bradosticus Maassoumi & Podlech, spec. nov.

Holotype: Iran, Azerbayjan, Oroumieh, Mavana, Hakki mt. W of the village Hakki, 2100–2700 m, 31.7.1995, *V. Mozaffarian, R.R. Maassoumi & Safavi 75442* (TARI; iso: MSB).

Differt ab *A. demonstrato* Maassoumi stipulis 8–10 (nec 15–18) mm longis, foliolis minoribus, 6–10 × 1,5–3 (nec 10–23 × 2–3) mm, calyce 12–15 (nec 16–19) mm longo, vexillo ca. 16 (nec 22–26) mm longo, lamina alarum 6.5–7 × 2–2,5 (nec 11–12 × 2–3) mm.

Plants suffruticose, caespitose, spiny, 17–20 cm tall, subacaulescent. Stems up to 10 cm long, branched at the base, in older parts densely covered with greyish-brown remnants of old leaves, parts of the current year ca. 1 cm long. Stipules thinly hyaline-membranous, pale yellowish, 8–10 mm long, adnate to the petiole for 4–5 mm, shortly connate behind the stem, the free tips narrowly triangular-acuminate, glabrous or sparsely ciliate at the margins. Leaves 4–7 cm long; petiole 1–1.5 cm long, like the rhachis rather densely to densely covered with subappressed to partly slightly ascending hairs 0.2–0.5 mm long and with few ascending hairs up to 1 mm long, spiny. Leaflets in 6–7 pairs, narrowly elliptic, 6–10 × 1.5–3 mm, at the apex acuminate-aristate, pungent, with a cusp 0.5–1 mm long, on both sides rather densely to densely covered with subappressed to partly slightly ascending hairs 0.3–0.5 mm long. Peduncles very short to nearly absent, with spreading hairs. Racemes nearly globular, 2.5–3 cm long and ca. 2.5 cm in diameter, rather densely many-flowered. Bracts partly falling, thinly membranous, 8–15 mm long and 4–5 mm wide, ovate to narrowly ovate, acuminate, glabrous or sparsely hairy, especially near the base and along the mid-line, ciliate at the margins. Calyx during the anthesis tubular, later on slightly inflated, 12–15 mm long and ca. 4 mm wide, whitish-yellow or sometimes towards the apex with purplish nerves, rather densely covered with ascending to spreading hairs 0.3–0.5 mm long and with ascending hairs 1.5–3 mm long; teeth subulate, purple, 6–7 mm long. Petals purplish-violet, soon fading to yellowish. Standard ca. 16 mm long; blade ca. 7 mm wide, obovate, slightly emarginate at the apex, at the base not hastate-auriculate but subangularly narrowed into the short cuneate claw. Wings 15–16 mm long; blades narrowly elliptic, at the apex obtuse, 6.5–7 × 2–2.5 mm; 11–12 × 2–3 mm; auricle ca. 0.3 mm long, claw 10–11 mm long. Keel ca. 13 mm long; blades obliquely obovate, acutish at the apex, ca. 4.5 × 2 mm; auricle short, claw 10–11 mm long. Ovary subsessile, ca. 4 mm long, densely subappressed hairy; style glabrous. Legumes unknown.

Other specimens seen:

Iran. Azarbaijan Garbi: Oroumieh, Silvana, mts. W of the village, 1700–2100 m, 31.7.1995, *Mozaffarian, Maassoumi & Safavi 75424* (MSB, TARI).

Astragalus doghrunensis Maassoumi & Podlech, spec. nov.

Holotype: Iran, Azarbayejan Sarki: Arasbaran protected area, Doghrun mountain, 2500–2800 m, 13.7.1977, *M. Assadi & H. Sardabi 23974* (TARI).

Differt ab *A. recognito* Fisch. stipulis hyalino-membranaceis, albidis (nec chartaceis, flavidis), foliolis utrinque pilis appressis vel subappressis laxe vel interdum densiuscule obtectis (nec dense ad densissime pilosis), pedunculis densiuscule pilis appressis, ± rectis brevibus (nec pilis confusis crispis subappressis) et paucioribus 1–1,5 mm longis obtectis, bracteis glabris (nec saltem partim pilosis), calyce 11–13 (nec 13–18) mm longo, dentibus 4–5 (nec 5–8) mm longis.

Plants 18–20 cm tall, caespitose. Stems 6– 10 cm long, the lower parts ligneous, branched, densely covered with blackish remnants of old leaves, part of the current year 1–2 cm long. Stipules hyaline-membranous, whitish, 12–18 mm long, adnate to the petiole for 6–10 mm, connate for 1–2 mm, the free tips narrowly triangular-acuminate, many-nerved, glabrous or more rarely the lower ones hairy, ciliate at the margins with ascending hairs up to 1 mm long. Leaves 2–6 cm long; petiole 1–2 cm long, like the rhachis densely covered with appressed to partly slightly ascending hairs 0.2–0.5 mm long. Leaflets in 5–7 pairs, narrowly elliptic, 5–9 × 1.5–3 mm, acuminate with a cusp 0.5–1 mm long, on both sides loosely to more rarely rather densely covered with appressed to subappressed hairs 0.4–0.8 mm long. Peduncles 5–8 cm long, ± as long as the leaves, rather densely covered with ± appressed, short hairs 0.3–0.5 mm long and with much fewer hairs 1–1.5 mm long. Racemes 3–4 cm long and 2–2.5 cm in diameter, rather densely many-flowered. Bracts chartaceous, not hyaline, yellowish, lower ones or all mostly easily falling, 9–10 mm long, 3–5 mm wide, ovate, long acuminate, glabrous, ciliate. Calyx pale yellowish, at first tubular, soon becoming elliptic- to globose-inflated, 11–13 mm long, 5–7 mm wide, loosely to rather densely covered with short hairs 0.2–0.5 mm long and with ascending hairs 1–1.5 mm long; teeth subulate, 4–5 mm long. Petals pale yellow. Standard ca. 19 mm long; blade obovate-panduriform, ca. 7 mm wide, rounded but minutely mucronulate at the apex, slightly constricted below the middle, angular-hastate at the base, with widely cuneate claw. Wings ca. 16 mm long; blades narrowly obovate, rounded at the apex, 6–6.5 × 2.8–3 mm; auricle ca. 0.3 mm long, claw ca. 10 mm long. Keel ca. 15 mm long; blades obliquely obovate, with in upper part rectangularly curved lower edge and slightly convex upper edge, at the apex subacute, ca. 5 × 2.8 mm; auricle minute, claw 10 mm long. Ovary narrowly elliptic, ca.4 mm long, densely appressed hairy; style hairy at the base. Legumes unknown.

Other specimen seen:

Iran. Azarbaijan Sarki: Arasban protected area, Doghrun mountain, 2500 m, 15.7.1977, *Assadi & Sardabi 23921* (TARI).

Astragalus marivanensis Podlech & Maassoumi, spec. nov.

Holotype: Iran, prov. Kordestan, 50 km from Baneh to Marivan, 1650 m, 30.5.1978, *H. Runemark & V. Mozaffarian 29326* (TARI; iso: MSB).

Differt ab *A. chrysostachyde* Boiss. petiolo rhachideque pilis laxe ad dense patentibus (nec appressis vel subappressis obtecto, foliis 6–9-jugis (nec 4–7-jugis), utrinque pilis oblique patentibus (nec appressis ad subappressis) obtectis, pedunculo pilis patentibus (nec appressis) obtecto, bracteis dorso in linea mediana pilosis (nec glabris), calyce 17–20 (nec 13–16) mm longo, dentibus 8–10 mm (nec 4–6 mm) longis.

Plants suffruticose, caespitose, spiny, 20–30 cm tall. Caudex very thick, up to 2 cm in diameter, branched. Stems 5–10 cm long, the lower parts ligneous, covered with dark brownish bark and remnants of old leaves, branched, parts of the current year 1.5–3 cm long, completely covered by leave stipules. Stipules hyaline-membranous, 10–18 mm long, adnate to the petiole for 5–9 mm, connate behind the stem for 1–3 mm, the free tips narrowly triangular-acuminate, glabrous. Leaves 4–12 cm long; petiole 1.5–3.5 cm long, like the rhachis loosely to densely covered with spreading hairs 0.2–0.5 mm long, spiny, at the insertion of leaflets with minute ovoid, subsessile glands. Leaflets in 6–9 pairs, narrowly elliptic, 6–20 × (1.5–)2–5 mm, acuminate, pungent, with a cusp 0.5–2 mm long, on both sides loosely to densely covered with ascending to sometimes ± spreading hairs (0.3–)0.6–1.5 mm long. Peduncles 8–15 cm long, erect or ascending, rather densely to densely covered with ascending to spreading, tangled, curly hairs 0.2–0.5 mm long and with ± straight, spreading hairs 1–2 mm long, sometimes glabrescent in upper part. Racemes ovoid to shortly cylindric, 4–10 cm long and 3–3.5 cm in diameter, densely many-flowered. Bracts partly falling, membranous, hyaline towards the margins, pale yellowish, 10–15 mm long and 4–6 mm wide, narrowly ovate-acuminate, shortly aristate, hairy along the midline. Calyx 17–20 mm long, at the beginning of anthesis tubular, slightly ventricous, later on ovoid-inflated and 5–6 mm wide, pale yellowish, rather densely covered with ascending to ± spreading hairs 2.5–3.5 mm long; teeth subulate, 8–10 mm long. Petals pale yellow. Standard ca. 20 mm long; blade ca. 6 mm wide, obovate-panduriform, obtuse to minutely mucronulate at the apex, distinctly constricted in lower part, at the base ± sharply angular-auriculate, abruptly narrowed into the narrowly cuneate claw. Wings ca. 18 mm long; blades elliptic, at the apex obtuse, ca. 7 × 2.5 mm; auricle minute, ca. 0.3 mm long, claw ca. 11 mm long. Keel ca. 15 mm long; blades obliquely obovate; with widely, sometimes nearly rectangular-curved lower edge and nearly straight upper edge, acutish at the apex, ca. 5 × 2.5 mm; auricle minute, claw ca. 10 mm long. Ovary ca. 5 mm long, elliptic, very densely ascending hairy; style glabrous. Legumes unknown.

Other specimens seen:

Iraq. Rowanduz distr. (MRO): in montis Kuh-Sefin, 1100–1200 m, 2.5.1893, *Bornmüller 1177, 1177b* (B) – in monte Handarin [Handren], 1300 m, 28.7.1893, *Bornmüller 1178* (B).

Iran. Kordestan: ca. 35 km from Baneh on road to Mahabad, after Kavalan, Ganeh-Dar village, 1650 m, 13.6.2000, *Maassoumi & Nikchehreh 80225* (MSB, TARI) – ca. 46 km from Sanandaj on the road to Saghez, 5 km after Iran-shah, 2000 m, 13.6.2000, *Maassoumi & Nikchehreh 80213, 80214* (MSB, TARI).

Astragalus pseudopersicus Podlech & Maassoumi, spec. nov.

Holotype: Iran, prov. Azarbaijan Sarki, ca. 5 km S of Tabriz to Sperkhan, 1600 m, 3.7.1991, *V. Mozaffarian 69853* (TARI; iso: MSB).

Differt ab *A. persicus* pedunculis crassis, ca. 2.5 mm diametro (nec sat tenuibus, ca. 1 mm diametro), bracteis 14–17 (nec 5–8) mm longis, 6–7 (nec 4–5) mm latis, sat longe acuminati-aristatis (nec breviter acuminatis), calyce 14–16 (nec 11–13) mm longo petalis ± aequilongo (nec eis distincte breviore), petalis pallide lilacina nec obscure purpurei-violaceis.

Plants suffruticose, caespitose, spiny, 25–35 cm tall. Stems 10–15 cm long, the older parts ligneous, branched, covered with blackish remnants of old leaves, parts of the current year 1.5–3 cm long, densely covered with nearly spreading hairs up to 2 mm long, but mostly completely covered by the stipules. Stipules chartaceous, pale yellowish, 15–18 mm long, with in basal part reticulate nerves, adnate to the petiole for 8–10 mm, connate behind the stem for 2–3 mm, the free tips triangular to long acuminate, ciliate at the margins with hairs up to 1 mm long. Leaves 7–12 cm long; petiole 1.5–3 cm long, like the rhachis rather densely to densely covered with ± spreading, tangled, often flexuose hairs 0.3–0.8 mm long. Leaflets in 5–6 pairs, narrowly elliptic, 10–20 × 2–3 mm, at the apex acuminate-aristate, pungent, with a cusp 1–2 mm long, on both sides densely covered with subappressed to ascending hairs 0.5–1 mm long. Peduncles 7–13 cm long, thick, up to 2.5 mm in diameter, as long as to longer than the leaves, densely covered with tousled, ± spreading hairs 0.2–2 mm long. Racemes ovoid to shortly cylindric, 4–6 cm long, 2.5–3 cm wide, densely many-flowered. Bracts partly falling, membranous, but scarcely hyaline at the margins, whitish-yellowish, towards the tip mostly purple, (12–)14–17 mm long, 6–7 mm wide, ovate to widely ovate, ± long acuminate-aristate, rather densely to densely subappressed hairy, with hairs 0.3–1 mm long. Calyx at first tubular, later on slightly inflated, 14–16 mm long, 3–4 mm wide, whitish with pale purplish teeth, rather densely covered with ascending to spreading hairs 2.5–4 mm long; teeth subulate, 4–6 mm long. Petals in dry state pale lilac to violet. Standard 15–17 mm long, ± as long as calyx teeth; blade 5–5.5 mm wide, obovate-panduriform, rounded to slightly retuse at the apex, slightly constricted below the middle, at the base shortly angular-hastate, gradually narrowed into the cuneate claw. Wings 14–16 mm long; blades narrowly elliptic, obtuse at the apex, 5–7 × 1.8–2.4 mm; auricle short, claw 9–10 mm long. Keel 13–14 mm long; blades obliquely obovate, with in upper part curved lower edge and ± straight upper edge, subacute at the apex, 5 × 2.5–3 mm; auricle indistinct, claw 8–9 mm long. Ovary sesssile, ca. 5 mm long, ellipsoidic, densely hairy; style hairy in lower part. Legumes unknown.

Other specimen seen:

Iran. Azarbaijan Sarki: Sahand, S. of Sperkhan, 2500–2850 m, 10.9.1981, *Mozaffarian & Mohammadi 37535* (TARI).

Astragalus qoturensis Podlech, spec. nov.

Holotype: Iran, Azarbaijan Garbi, Kuh Kani Ziarat N Habashi Bala prope Qotur, 2300–3000 m, 18.7.1974, *W.Rechinger & J. Renz* in Rechinger *49644* (M; iso: TARI, W).

Differt ab omnibus speciebus sectionis *Hymenostegis* vexillo dorso sparse subappresse piloso.

Plants suffruticose, caespitose, spiny, 18–22 cm tall. Stems 6–10 cm long, the older parts ligneous, divided, in upper parts covered with dark grey-brownish remnants of old leaves, parts of the current year 1.5–2 cm long. Stipules hyaline-membranous, whitish, 12–15 mm long, with many, at the base netlike nerves, therefore netlike dissoluting with age, adnate to the petiole for 6–8 mm, connate behind the stem for 2–3 mm, the free tips narrowly triangular, ciliate at the margins with spreading hairs up to 1 mm long. Leaves (2–)3–9 cm long; petiole 0.8–2.5 cm long, like the rhachis densely covered with tangled, appressed to subappressed hairs 0.05–0.4 and with fewer hairs up to 1 mm long, spiny. Leaflets in (2–)6–8 pairs, narrowly elliptic, 7–12 × 1.5–3 mm, at the apex acuminate-aristate, pungent, with a cusp ca. 1 mm long, on both sides densely to very densely covered with subappressed hairs 0.3–0.8(–1) mm long. Peduncles 5–8 cm long, as long as or slightly longer than the leaves, densely covered with short, appressed to subappressed hairs 0.3–0.8 mm long and with fewer, longer, subappressed to slightly ascending hairs up to 2 mm long. Racemes globular to ovoid, 2.5–4 cm long, 2–2.5 cm wide, densely many-flowered. Bracts partly falling, chartaceous, yellowish, 7–12 mm long, 3–4.5 mm wide, ovate-acuminate, partly with an awn up to 5 mm long, loosely to rather densely covered with subappressed to slightly ascending hairs. Calyx at first tubular, slightly inflated, later on ovoid-inflated, 12–14 mm long, 4–5 mm wide, whitish with purplish teeth, rather densely covered with short, flexuose hairs 0.3–0.5 mm long and with ascending to nearly spreading hairs 1–2 mm long; teeth subulate, 4–5 mm long. Petals violet, with standard sparsely hairy on the back. Standard ca. 17 mm long; blade ca. 7 mm wide, oblong, retuse at the apex, not or scarcely constricted below the middle, at the base indistinctly obtusely angular, gradually narrowed into the cuneate claw. Wings ca. 16 mm long; blades narrowly elliptic, obtuse at the apex, ca. 7 × 2.5 mm; auricle ca. 0.4 mm long, claw ca. 9 mm long. Keel ca. 13 mm long; blades obliquely obovate, with widely rectangularly curved lower edge and slightly convex upper edge, acutish at the apex, ca. 5 × 3 mm; auricle indistinct, claw ca. 9 mm long. Ovary sessile, ellipsoidic, ca, 5 mm long, densely hairy; style hairy in lower part. Legumes unknown.

Prof. Dr. Dietrich PODLECH, Institut für Systematische Botanik der Ludwig-Maximilians-Universität München, Menzinger Straße 67, D-80638 München, Germany.
Dr. A.A. MAASSOUMI, Research Institute of Forests & Rangelands, P.O.Box 13185-116, Tehran, Islamic Republic of Iran.

Lichenicolous fungi from Bavaria as represented in the Botanische Staatssammlung München

D. TRIEBEL & P. SCHOLZ

Abstract:
TRIEBEL, D. & SCHOLZ, P.: Lichenicolous fungi from Bavaria as represented in the Botanische Staatssammlung München. – Sendtnera 7: 211–231. 2001. ISSN 0944–0178.

The alphabetical list below includes the lichenicolous fungi from Bavaria as represented in the herbarium of lichenicolous fungi at the Botanische Staatssammlung München (M). It compiles 136 taxa from Bavaria, 20 of these are for the first time reported from Germany and 9 of these are for the first time reported from Bavaria. The new combination *Stigmidium lichenum* (Arnold) Triebel & P. Scholz comb. nov. is proposed. Lectotype and isolectotype specimens for this taxon are designated.

Zusammenfassung:
Es werden die lichenicolen Pilze aus Bayern, die im Herbarium lichenicoler Pilze der Botanischen Staatssammlung München (M) aufbewahrt werden, alphabetisch gelistet. Die Liste umfaßt 136 Taxa aus Bayern, 20 davon werden erstmals für Deutschland, 9 erstmals für Bayern angegeben. Die Neukombination *Stigmidium lichenum* (Arnold) Triebel & P.Scholz wird vorgeschlagen. Für diese Art werden Lecto- und Isolectotypus festgelegt.

Introduction

When preparing a checklist of the lichens and lichenicolous fungi of Germany (SCHOLZ 2000) it became once more evident that the knowledge about the occurence and distribution of lichenicolous fungi in Germany is rather poor. Many names of lichenicolous fungi with records from Germany published by KEISSLER (1930) and some other authors are now ambiguous. The reason is that major changes of genus and species concepts took place and that within certain groups it is more or less impossible today to use some names without checking the original herbarium material.

The largest collection of lichenicolous fungi in Germany is housed at the Botanische Staatssammlung München (M). The majority of the specimens there was collected by F. Arnold, A. von Krempelhuber and H. Rehm in the second half of the 19th century. These authors had an excellent knowledge of this group of fungi, described a number of new species and distributed them in several exsiccatae. Therefore, still today the knowledge of

lichenicolous fungi in Bavaria is mostly based on the collections made by them. Apart from specimens where the lichenicolous fungi are discovered by the collector, a large number of specimens are collected incidentally as part of lichen samples. In these cases the collector given on the label is the person who collected the host lichen and not the person who realised the presence of the lichenicolous fungus. Its presence was discovered later by someone studying the lichen more closely or by someone who was explicitly screening herbarium material of potential host lichens for lichenicolous fungi. In certain cases the later specific search was done by the first author ("det. D. T." in the list below).

The list includes all species of lichenicolous fungi from Bavaria represented in the herbarium of lichenicolous fungi at the Botanische Staatssammlung München until the end of 2000. For each species with up to five specimens in M, full information on the governmental district "Regierungsbezirk" (underlined), locality (as given on the label), collector(s), date of collecting (month, year) and host lichen is given. Host lichens [in square brackets] are named according to SCHOLZ (2000). In certain cases notes are added. Species with more than five Bavarian collections are cited by only four representative specimens and notes on the number of the additional material. References to recently published records from Bavaria based on material from M are given instead of repeating these records. Records of lichenicolous fungi in Bavaria were published especially by KREMPELHUBER (1861) and ARNOLD (various publications, see references). The material cited in these publications can generally be found in M (see references after the citation of the specimens).

The list includes 136 taxa from Bavaria. More than 40 of them are not mentioned in the first checklist of lichenicolous fungi of Germany (WIRTH 1994) for various reasons, some of course because they were not yet described at that time. The recent online-checklists of FEUERER (2001a, b) give only about 30 species of lichenicolous fungi from Bavaria. Species which are – as far as known – newly published for Germany are marked with two asterisks (20 species), those newly recorded for Bavaria with one asterisk (9 species). In this context has to be mentioned that some of this information is already included in SCHOLZ (2000) referring to TRIEBEL & SCHOLZ (in prep.).

Lichenicolous fungi of Bavaria were distributed in the following exsiccatae: Arnold, Lich. Exs. Lich. Jur.; Arnold, Lich. Exs.; Arnold, Lich. Monac. Exs.; Hepp, Flechten Europ.; Hertel, Lich. Alp.; Poelt, Lich. Alp.; Poelt & Steiner, Lich. Alp.; Rabenhorst, Fungi Europ. Exs.; Rabenhorst, Lich. Europ. Exs.; Rehm, Ascomyc.; Thümen, Mycoth. Univ.; Triebel, Microf. Exs. The abbreviations follow Triebel (2001). These series are effective publications and the material is widely distributed in public herbaria.

List of species

Abrothallus bertianus De Not.

Schwaben: Landkreis Füssen, Bleckenau, *Schröppel & Doppelbaur*, June 1963, sub *Karschia bayrhofferi*, [on *Melanelia glabratula*]. – Oberbayern: Hirschpark bei Eichstätt, *Arnold*, June 1865, sub *Abrothallus smithii*, Arnold, Lich. Exs. Lich. Jur. 319, [on *Melanelia glabratula*], rev. J. Hafellner, (ARNOLD 1885: 222) – Forstenrieder Park westlich von Baierbrunn, München, *Arnold*, July 1896, sub *Abrothallus parmeliarum*, Arnold, Lich. Monac. Exs. 453, [on *Melanelia glabratula*], (two additional collections: Forstenrieder Park, *Arnold*) – Wallgauer Berge, Landkreis Tölz, Oberes Isartal zwischen Wallgau und Vorderriß unweit "Schröfeln", *Hertel 19757*, Mar. 1979, sub *Abrothallus parmeliarum*, [on *Melanelia glabratula*]. – Several additional specimens from Bavaria in M.

Abrothallus caerulescens C.Kotte

Oberpfalz: Vorderer Bayerischer Wald, am Seidelberg östlich Brennberg, *Schuhwerk 1437*, Dec. 1979, [on *Xanthoparmelia somloensis*], det. C. Hauger.

Abrothallus cetrariae C.Kotte

Oberbayern: Im Walde vor der vorderen Oesteralpe, Partenkirchen, *Arnold*, Aug. 1875, [on *Platismatia glauca*], (ARNOLD 1877a: 281).

Abrothallus microspermus Tul.

Schwaben: Schwalbenwald bei Wemding, *Arnold*, Aug. 1865, [on *Flavoparmelia caperata*], (ARNOLD 1865: 598). – Oberbayern: Beim Buchhof, Starnberg bei München, *Arnold*, Apr. 1900, [on *Flavoparmelia caperata*], (ARNOLD 1891: 13) – Wald bei der Menterschwaige, München, *Kummer*, Mar. 1854, [on *Flavoparmelia caperata*], with *Vouauxiomyces truncatus* – Föhren bei der kalten Herberge, München, *Arnold*, Aug. 1855, [on *Flavoparmelia caperata*], (KREMPELHUBER 1861: 275). – Two additional specimens from Bavaria in M.

Abrothallus parmeliarum (Sommerf.) Arnold

Schwaben: Höhe zwischen Breitenberg und Aggenstein bei Pfronten, Allgäuer Alpen, *Poelt*, Sept. 1956, [on *Parmelia saxatilis*], with *Phacopsis oxyspora* var. *oxyspora*. – Oberbayern: Heimgarten, *Schauer*, July 1964, [on *Parmelia saxatilis*] – Im Schweinsparke unterhalb der Eustachius Kapelle bei Eichstätt, *Arnold*, Nov. 1861, sub *Abrothallus smithii*, [on *Parmelia sulcata*] – Berchtesgaden, *Krempelhuber*, 1855, sub *Parmelia saxatilis* var. *parasitica*, [on *Parmelia sulcata*], (KREMPELHUBER 1861: 275). – A number of additional specimens from various regions of Bavaria in M, see also ARNOLD (1897: 38).

Abrothallus peyritschii (Stein) C.Kotte

Schwaben: Rappenalpenthal im Allgäu, *Rehm*, 1860, [on *Vulpicida pinastri*] – Auf Bretterwänden in Oberstdorf im Allgäu, *Rehm* [?], [no date], [on *Vulpicida pinastri*] – Allgäuer Alpen, *Rehm*, [no date], [on *Vulpicida pinastri*], (REHM 1890: 360). – Oberbayern: Bretterplanken bei Bad Kreuth, *Bausch*, 1858, [on *Vulpicida pinastri*].

Abrothallus prodiens (Harm.) Diederich & Hafellner

Mittelfranken: Windsbach, Mittelfranken, *Vill*, Mar. 1926, sub *Abrothallus parmeliarum*, [on *Hypogymnia physodes*]. – Schwaben: Landkreis Augsburg, nordöstlich Rommelsried, *Doppelbaur*, Sept. 1949, sub *Abrothallus parmeliarum*, [on *Hypogymnia physodes*]. – Oberbayern: Bei Großhesselohe, München, *Schnabl*, Apr. 1896, sub *Abrothallus parmeliarum*, Arnold, Lich. Monac. Exs. 452, [on *Hypogymnia physodes*], two specimens of this exsiccata – Pietenfelder Höhe bei Eichstätt, *Arnold*, 1857, sub *Abrothallus smithii*, [on *Hypogymnia physodes*], (ARNOLD 1885: 222). – Eight additional specimens from Bavaria especially from the surroundings of München in M.

Adelococcus alpestris (Zopf) Theiss. & Syd.

Oberbayern: Dolomit oberhalb Schambach zwischen Eichstätt und Kipfenberg, *Arnold*, 1859, sub *Polyblastia discrepans*, [on *Acarospora glaucocarpa*], rev. D. T., conf. M. Matzer & J. Hafellner.

Adelococcus interlatens (Arnold) Matzer & Hafellner

Oberbayern: [Fränkischer Jura] Kalkfelsen der Schluchten bei Obereichstätt, *Arnold*, Febr. 1876, sub *Verrucaria interlatens*, conf. M. Matzer & J. Hafellner.

Arthonia apotheciorum (A.Massal.) Almqu.

Mittelfranken: Auf Keupersandstein bei Sugenheim in Franken, *Rehm*, 1868, sub *Conida clemens*, Arnold, Lich. Exs. Lich. Jur. Exs. 396b, [on *Lecanora albescens*], (ARNOLD 1885: 220) – An Süßwasserdolomitblöcken des kahlen Abhangs oberhalb Bubenheim bei Weissenburg, *Arnold*,

May 1868, sub *Conida clemens*, Arnold, Lich. Exs. Lich. Jur. 396a, [on *Lecanora albescens*], (ARNOLD 1868: 523, 1885: 220). – Oberbayern: Ziegel der Kirchhofmauer in Dornach bei München, *Arnold*, Sept. 1891, [on *Lecanora albescens*], (ARNOLD 1892: 26).

Arthonia destruens Rehm

Mittelfranken: Bei Obernesselbach in Franken, *Rehm*, 1867, sub *Conida destruens*, Arnold, Lich. Exs. Lich. Jur. 377, [on *Physcia stellaris* (*P. aipolia*, *P. tenella*)] – Bei Obernesselbach (Sugenheim) in Franken, *Rehm*, 1867, sub *Arthonia destruens*, Rabenhorst, Lich. Europ. Exs. 816, [on *Physcia stellaris*], isolectotype – Bei Sugenheim in Franken, *Rehm*, 1867, [on *Physcia stellaris*], (KEISSLER 1930: 83, REHM 1891: 423). – Schwaben: Pfronten-Berg, *Mayr*, July 1924, [on *Physcia stellaris*].

Arthonia epiphyscia Nyl.

Mittelfranken: Bei Sugenheim in Franken, *Rehm*, 1868, sub *Arthonia destruens* var. *maculans*, Arnold, Lich. Exs. Lich. Jur. 397, [on *Xanthoria parietina*], (KEISSLER 1930: 83).

Arthonia glaucomaria Nyl.

Syn. ? *Lichen varians* Davies (to be typified on the host lichen)

Oberfranken: Bayreuth, *Walther & Thümen*, 1874, sub *Celidium grumosum*, Thümen, Mycoth. Univ. 572, [on *Lecanora swartzii*] – Quarzblöcke zwischen Neudorf und Pegnitz in Oberfranken, *Arnold*, May 1861, sub *Celidium varians*, Arnold, Lich. Exs. Lich. Jur. 210, [on *Lecanora rupicola*], (ARNOLD 1862: 313, 1885: 221). – Oberpfalz: Auf Basaltblöcken der rauhen Culm bei Neustadt in der Oberpfalz, *Arnold*, Sept. 1861, sub *Celidium varians*, Arnold, Lich. Exs. Lich. Jur. 211, [on *Lecanora rupicola*]. – Schwaben: Allgäuer Alpen (Gottesackerwände), *Gümbel*, [on *Lecanora rupicola*]. – Ten additional specimens from Bavaria in M.

Arthonia intexta Almqu.

Oberbayern: Berchtesgadener Land, Hocheck-Gipfel des Watzmanns, *Wunder 1058*, Aug. 1969, [on *Lecidella patavina*] – Berchtesgadener Land, Hochkalter, Gipfelbereich, *Türk 24445*, July 1997, [on *Lecidella* spec.] – Bayerische Alpen, Breitenstein über Fischbachau, *Hertel 17767*, July 1977, [on *Lecidella stigmatea*]. – For further specimens from Bavaria in M see HERTEL (1969), TRIEBEL (1989: 62).

Arthonia molendoi (Heufl. ex Frauenf.) R.Sant.

Oberbayern: Kalkwand ober der Weitalm am Hochgern bei Wessen, [Chiemgauer Berge], *Arnold*, Sept. 1868, [on *Caloplaca* spec.], two specimens (ARNOLD 1869: 254) – Mutmaßlich bei Eichstätt (scr. Lahm), *Fuisting*, [no date], [on *Caloplaca* spec.].

****Arthonia peltigerea*** Th.Fr.

Schwaben: Allgäu, [without indication of collector and date], [on *Solorina bispora* var. *bispora*], det. D. T.

Arthonia phaeophysciae Grube & Matzer

Schwaben: Landkreis Füssen, in Pfronten-Ried, *Klement*, 1954, [on *Phaeophyscia orbicularis*], det. D. T. – Erroneously omitted by SCHOLZ 2000 (see GRUBE & MATZER 1997).

Arthonia punctella Nyl.

Oberfranken: Kalkfelsen des Görauer Angers östlich von Weismain in Oberfranken, *Arnold*, Sept. 1887, [on *Buellia epipolia*], (ZOPF 1897: 143).

Arthonia subfuscicola (Linds.) Triebel

Mittelfranken: Obernesselbach unweit Sugenheim in Mittelfranken, *Rehm*, 1867, sub *Celidium varians* var. *pallidae* (*C. grumosum*), Arnold, Lich. Exs. Lich. Jur. 376, [on *Lecanora albella*],

lectotype and isolectotype of *Arthonia glaucomaria* var. *pallidae*, (ARNOLD 1885: 221) – Bei Obernesselbach in Franken, *Rehm*, 1871, sub *Celidium varians* f. *pallidae*, Rehm, Ascomyc. 576, two specimens, [on *Lecanora albella*] (ARNOLD 1885: 221). – Oberbayern: Südlich bei Schleissheim, München, *Arnold*, April 1893, sub *Conida pallidae*, [on *Lecanora* cf. *albella*], (ARNOLD 1897: 38, sub *Conida apotheciorum*), rev. D. T.

Arthonia subvarians Nyl.

Syn. *Arthonia vagans* var. *lecanorina* Almqu.

Oberfranken: Kalkfelsen des Görauer Angers östlich von Weismain in Oberfranken, *Arnold*, Sept. 1887, [on *Lecanora muralis*]. – Oberbayern: Vor dem Hirschparke bei Eichstätt, *Boll*, 1887, [on *Lecanora carpinea*] – Hornsteine bei Nassenfels, Eichstätt, *Arnold*, 1859, [on *Lecanora hagenii*] (ARNOLD 1868: 523, 1885: 220), det. D. T. – Basispyramide östlich bei Föhring, München, *Arnold*, May 1888, [on *Lecanora hagenii*], (ARNOLD 1891: 130) – Steinhaufen zwischen Dettenhausen und Egling, München, *Arnold*, Sept. 1888, [on *Lecanora polytropa*] – Same locality and host data, *Arnold*, Aug. 1890, (ARNOLD 1891: 130) – Bei Ebenhausen, München, *Arnold*, May 1894 sub *Conida pallidae* [on *Lecanora* cf. *carpinea*], (ARNOLD 1897: 38 sub *Conida apotheciorum*), rev. M. Grube, growing together with *Vouauxiella lichenicola*.

Arthopyrenia microspila Körb.

Syn. *Stigmidium microspilum* (Körb.) D.Hawksw.

Schwaben: An Buchen bei Oberstdorf, *Krempelhuber* (?), [no date], [on *Graphis scripta*]. – Oberbayern: An Buchen im Walde des Frühauf bei Eichstätt, *Arnold*, July 1862, [on *Graphis scripta*] – Im Wald zwischen Percha und Neufahrn bei Starnberg, München, *Arnold*, Sept. 1889, [on *Graphis scripta*], (ARNOLD 1891: 120). – Niederbayern: Im Donauthal zwischen Kelheim und Weltenburg, *Arnold*, Aug. 1860, [on *Graphis scripta*]. – Three additional specimens collected by Arnold at different localities in the vicinity of München in M.

Arthopyrenia punctillum Arnold

Syn. *Stigmidium punctillum* (Arnold) D. Hawksw.

Oberbayern: Kampenwand bei Niederaschau, Bayerische Alpen, *Arnold*, Sept. 1873, [probably not lichenicolous], (ARNOLD 1874b: 380).

Athelia arachnoidea (Berk.) Jülich

Mittelfranken: [?]region of Ansbach, *Kaiser*, 1862, sub *Illosporium roseum*, [on *Xanthoria parietina*, *Physcia adscendens*], det. P. Diederich. – Oberpfalz: Lichtenberg, Umgebung Regensburg, *Killermann*, Nov. 1918, sub *Corticium centrifugum*?, [on or beside lichens], det. W. Jülich. – Schwaben: Pfronten, Friedhof, *Doppelbaur*, 1952, sub *Illosporium roseum*, [on *Physcia* spec.], det. P. Diederich.

Bachmanniomyces uncialicola (Zopf) D.Hawksw.

Oberfranken: Glashütten, *Arnold*, Sept. 1884, sub *Cladonia uncialis* f. *leprosa*, [on *Cladonia uncialis*] (ARNOLD 1885: 228) – Muthmannsreuth, Bayreuth, *Arnold*, Sept. 1884, sub *Cladonia uncialis* f. *leprosa*, [on *Cladonia uncialis*]. – Mittelfranken: Nürnberg, *Rehm*, 1853, sub *Cladonia uncialis* f. *leprosa*, [on *Cladonia uncialis*]. – Oberpfalz: Auerbach, Oberpfalz, *Arnold*, Sept. 1884, sub *Cladonia uncialis* f. *leprosa*, [on *Cladonia uncialis*], (ARNOLD 1885: 228). – Schwaben: Alluvialsand bei den Schwalbmühlen, Wemding, *Arnold*, Aug. 1865, sub *Cladonia uncialis* f. *leprosa*, [on *Cladonia uncialis*], (ARNOLD 1884: 77).

Buellia pulverulenta (Anzi) Jatta

Oberbayern: An der Kalkhornsteinwand auf dem Hochgern in den bayerischen Alpen, *Arnold*, Aug. 1869, sub *Celidium muscigenae*, [on *Physconia muscigena*], rev. J. Hafellner 1979, (ARNOLD 1870b: 236).

Carbonea supersparsa (Nyl.) Hertel

Schwaben: Obermädli-Alpe, Allgäuer Alpen, *Rehm*, [no date], [on *Lecanora polytropa* agg.], det. G. Rambold & D. T.

Carbonea vitellinaria (Nyl.) Hertel

Mittelfranken: Sandsteinfelsen des braunen Jura zwischen Wülzburg und Weißenburg, *Arnold*, Aug. 1861, sub *Lecidea vitellinaria*, Arnold, Lich. Exs. Lich. Jur. 193a, [on *Candelariella vitellina*], (ARNOLD 1862: 389). – Schwaben: Sandsteinblöcke bei Pfronten und Zell bei Pfronten, *Schröppel & Poelt*, 1957, sub *Lecidea vitellinaria*, Poelt, Lich. Alp. 31, [on *Candelariella vitellina*]. – Oberbayern: Hirnschnitt eines Holzpfostens bei der Station Gauting, München, *Arnold*, Aug. 1890, sub *Lecidea vitellinaria*, [on *Candelariella vitellina*], (ARNOLD 1892: 26) – Steinhaufen zwischen Dettenhausen und Egling, München, *Arnold*, [no date], sub *Lecidea vitellinaria*, Arnold, Lich. Monac. Exs. 139, [on *Candelariella vitellina*], (ARNOLD 1891: 129). – Additional specimens from various regions of Bavaria; see also under *Polycoccum microsticticum*.

Cercidospora epipolytropa (Mudd) Arnold

Oberbayern: Gneisblock im Walde zwischen Irschenhausen und Wadlhausen, München, *Arnold*, June 1891, sub *Arthopyrenia lichenum*, [on *Lecanora polytropa*], rev. D. T. Further specimens collected by F. Arnold were sent on loan and therefore their label data are actually not citable.

Cercidospora macrospora (Uloth) Hafellner & Nav.-Ros.

Syn. *Cercidospora ulothii* Körb.

Schwaben: Allgäu, Lkrs. Füssen, Zell, Moor am Sulzbach, *Schröppel*, Aug. 1951, [on *Lecanora muralis*], det. D. T. – Two specimens from quite the same locality; occuring together with *Stigmidium squamariae*. Further specimens collected by F. Arnold were sent on loan and therefore their label data are actually not citable.

** ***Cercidospora verrucosaria*** (Linds.) Arnold

Schwaben: Allgäu, Krs. Füssen, am Aggenstein, *Klement*, 1950, [on *Megaspora verrucosa*], det. D. T. – Oberbayern: Berchtesgadener Land, Nationalpark, Funtensee Tauern, Gipfelbereich, *Türk 23764*, July 1995, [on *Megaspora verrucosa*], det. D. T.

Clypeococcum hypocenomycis D.Hawksw.

Oberbayern: Forstenrieder Park, südlich München, *Schwaiger 670*, Sept. 1985, [on *Hypocenomyce scalaris*] – Forstenrieder Park, südlich München, *Schwaiger 718*, Sept. 1985, [on *Hypocenomyce scalaris*] – Lkrs. Fürstenfeldbruck, Nannhofer Wald, c. 2.5 km NW of Mammendorf, *Triebel & Rambold*, Sept./Oct. 1993, Triebel, Microf. Exs. 78, [on *Hypocenomyce scalaris*].

****Cornutispora lichenicola*** D.Hawksw. & B.Sutton

Schwaben: Landkreis Oberallgäu (Allgäuer Alpen), Hindelang, Iseler Berg südlich von Oberjoch, *Triebel*, Sept. 1983, [on *Lecanora pulicaris*].

Corticifraga fuckelii (Rehm) D.Hawksw. & R.Sant.

Oberbayern: Kiesgrube am Anfang des Gleißenthals bei Deisenhofen, München, *Arnold*, Sept. 1893, [on *Peltigera canina* agg.], (ARNOLD 1897: 39). – Niederbayern: Kalkboden bei Gundelshausen an der Donau (Regensburg), *Arnold*, Oct. 1889, sub *Phragmonaevia fuckelii*, Rehm, Ascomyc. 1011, [on *Peltigera canina* agg.].

Corticifraga peltigerae (Nyl.) D.Hawksw. & R.Sant.

Mittelfranken: Waldgräben bei Ezelheim in Franken, *Rehm*, Sept. 1869, sub *Melaspilea peltigerae*, Rehm, Ascomyc. 19, [on *Peltigera* spec.], two specimens. – Oberbayern: Am Buchenwaldsaum des Gehänges zwischen Schöngeising und dem Jexhof, München, *Arnold*, Sept. 1894, [on *Peltigera praetextata*], (ARNOLD 1897: 39).

Cyphelium sessile (Pers.) Trevis.

Mittelfranken: Sugenheim an alter Eiche (gegen Markt Bibart zu), *Rehm*, [no date], [on *Pertusaria coccodes*], det. A. Schmidt 1962, L. Tibell 1969, (KREMPELHUBER 1861: 274). – Oberbayern: Grünwalder Park, alte Eiche, *Lederer*, May 1895, sub *Acolium inquinans*, [on *Pertusaria* spec.], det. A. Schmidt, (ARNOLD 1897: 30, SCHMIDT 1962: 117) – Eichstätt, *Arnold*, 1859, sub *Acolium stigonellum*, [on *Pertusaria* spec.], det. A. Schmidt 1962, L. Tibell 1969 – An einer alten Eiche hinter Sappenfeld bei Eichstätt, *Arnold*, 1859, [on *Pertusaria coccodes*], det. A. Schmidt 1962, L. Tibell 1969, two specimens, (ARNOLD 1885: 49, SCHMIDT 1962: 117).

Dacampia engeliana (Saut.) A.Massal.

Schwaben: Obermädli-Alpe im Allgäu, *Rehm*, [no date], [on *Solorina saccata*]. – Oberbayern: Kalkboden der Frauenalpe, Partenkirchen, Bayer. Alpen, *Arnold*, Aug. 1874, [on *Solorina saccata*] – Berchtesgaden, *Krempelhuber*, [no date], sub *Sagedia engeliana*, [on *Solorina saccata*] – Kalkwand an der Teufelskirche auf dem Hochgern in den Bayer. Alpen, *Arnold*, Sept. 1871, [on *Solorina saccata*]. – Two additional specimens from alpine regions of Schwaben and Oberbayern.

Dacampia hookeri (Borrer) A.Massal.

Schwaben: Am Kratzer und auf der Obermädli-Alpe bei Oberstdorf im Allgäu, *Rehm*, 1859, Arnold, Lich. Exs. Lich. Jur. 126, (KREMPELHUBER 1861: 232) – Allgäu, Kemtenkopf, *Sendtner*, [no date]. – Oberbayern: Watzmann, *Krempelhuber*, 1855 (KREMPELHUBER 1861: 232) – Benediktenwand, *Gattinger*, 1847. – A number of additional specimens from alpine regions of Schwaben and Oberbayern in M.

Dactylospora athallina (Müll.Arg.) Hafellner

Oberfranken: An Sandsteinfelsen des braunen Jura in schattigen Hohlwege zu Burglesau bei Scheßliz in Oberfranken, *Arnold*, July 1860, sub *Buellia saxatilis*, Arnold, Lich. Exs. Lich. Jur. 166a, [on *Baeomyces rufus*], det. J. Hafellner. – Mittelfranken: Im Keupersandsteinbruche bei Deutenheim in Franken, *Rehm*, 1860, sub *Buellia saxatilis*, Arnold, Lich. Exs. Lich. Jur. 166b, [on *Baeomyces rufus*], det. J. Hafellner – Auf Sandstein bei Dietenhofen in Franken, *Rehm*, [no date], sub *Buellia saxatilis*, Rabenhorst, Lich. Europ. Exs. 800, [on *Baeomyces rufus*], det. J. Hafellner. – Oberbayern: Blomberg bei Tölz in Oberbayern, *Arnold*, Sept. 1880, sub *Buellia athallina*, [on *Baeomyces* spec.], conf. J. Hafellner. – A number of additional specimens from various regions of Bavaria in M, see also HAFELLNER (1979: 102).

****Dactylospora deminuta*** (Th.Fr.) Triebel

Oberfranken: "Oberpfalz", Neuhaus, Veldensteiner Forst, Sandsteine am Schutzengelsteinbruch, *Arnold*, Sept. 1887, [on *Micarea peliocarpa*], det. D. T. – Oberbayern: Berchtesgaden, Schneibsteingipfel, *Rauchenberger*, [no date], [on *Lecanora epibryon*], det. D. T. – The latter specimen might represent a new taxon; see ZHURBENKO & SANTESSON (1996).

Dactylospora parasitaster (Nyl.) Arnold

Oberbayern: Ruine ober Erlingshofen, Eichstätt, *Arnold*, June 1869, [on *Chromatochlamys muscorum*], lichenicolous or bryophilous.

Dactylospora tegularum (Arnold) Hafellner

Oberbayern: Auf Ziegeln der Kirchhofmauer in Tutzing, München, *Arnold & Gmelch*, Sept. 1890, sub *Buellia tegularum*, Arnold, Lich. Exs. 1512, [on *Caloplaca arenaria*], holotype, (ARNOLD 1891: 130, HAFELLNER 1979: 149) – Ziegel der Kirchhofmauer in Buchendorf, München, *Arnold*, Sept. 1891, [on *Caloplaca arenaria*], three specimens, (ARNOLD 1892: 26, HAFELLNER 1979: 151).

Echinothecium reticulatum Zopf

Schwaben: Landkreis Füssen, Sandstein in Moorwiese bei Zell, *Schröppel*, May 1951, [on *Xanthoparmelia conspersa*], det. D. T.

Endococcus perpusillus Nyl.

Syn. *Endococcus macrosporus* (Arnold) Nyl.

Oberfranken: Quarzfelsen bei Pegnitz in Oberfranken, *Arnold*, 1869, [on *Rhizocarpon distinctum*]. – Schwaben: Bregenzer Wald, Südgrat des Fellhorn bei Oberstdorf, *Poelt*, Sept. 1964, sub *Tichothecium stigma*, [on *Rhizocarpon geographicum*]. – A number of additional specimens from Bavaria in M; see TRIEBEL (1989: 97).

Endococcus propinquus (Körb.) D.Hawksw.

Oberbayern: Kalkstein eines Steinhaufens zwischen Dettenhausen und Egling, München, *Arnold*, Aug. 1889, sub *Tichothecium gemmiferum*, [on *Verrucaria nigrescens*]. – A number of additional specimens from Bavaria in M; see TRIEBEL (1989: 102).

Endococcus rugulosus Nyl.

Mittelfranken: Quarzblock zwischen Neuhaus und Krottensee in der Oberpfalz, *Arnold*, Sept. 1882, sub *Tichothecium gemmiferum*, [on *Aspicilia cinerea*], two specimens.

Epicladonia sandstedei (Zopf) D.Hawksw.

Oberbayern: Bad Reichenhall, Kugelbachwald, *Schönau*, July 1929, sub *Diplodina sandstedei*, [on *Cladonia fimbriata*] – Berchtesgaden-Hintersee, Seeklause, auf einem Felsblock, *Schönau*, Aug. 1928, sub *Diplodina sandstedei*, [on *Cladonia fimbriata*].

Epigloea urosperma Döbbeler

Oberbayern: Landkreis Garmisch-Partenkirchen, Murnauer Moos, feuchte Wiese an der Straße zwischen Aschau und Eschenlohe, *G. & P. Döbbeler*, Aug. 1983, [on *Placynthiella uliginosa* s.l.], holotype. – For several additional specimens from Bavaria in M see DÖBBELER (1994: 278).

****Illosporiopsis christiansenii*** (B.L.Brady & D.Hawksw.) D.Hawksw.

Schwaben: Allgäu, Bezirk Pfronten, bei Zell, *Schröppel & Suessenguth*, Sept. 1951, sub *Illosporium roseum*, [on *Physcia stellaris*], det. D. T. – Allgäu, Buxheim bei Memmingen [or] Blaichach bei Immenstadt, *Rueß*, [?] 1899, sub *Illosporium roseum*, [on *Phaeophyscia orbicularis*], specimens from two localities intermixed, one is *Phaeophyscia* with *I. christiansenii*, det. D. T. – Oberbayern: Großhesselohe bei München, *Schnabl*, Oct. 1897, sub *Illosporium roseum*, [on *Physcia tenella*], det. D. T.

Illosporium carneum Fr.

Oberfranken: Erlangen, 500 m SSW Unterailsfeld bei Gößweinstein, *Mägdefrau*, Apr. 1941, [on *Peltigera* spec.]. – Oberbayern: Waldboden beim Buchhof unweit Starnberg bei München, *Arnold*, Sept. 1896, Arnold, Lich. Monac. Exs. 456, [on *Peltigera didactyla*], (ARNOLD 1897: 39) – Landkreis Fürstenfeldbruck, Haspelmoor, am Südwestrand, *Doppelbaur*, Apr. 1951, [on *Peltigera rufescens*] – Berchtesgaden, am Abstieg vom Trischhübel zum Wimbachtal, *Schoenau*, Aug. 1920, [on *Peltigera didactyla*]. – Five additional specimens from various regions of Bavaria in M.

Lichenoconium erodens M.S.Christ. & D.Hawksw.

Schwaben: Landkreis Oberallgäu, Hindelang, Oberjoch, westlich des Berghauses Iseler, *Triebel 375*, Sept. 1983, [on *Hypogymnia physodes*] – Landkreis Oberallgäu, Hindelang, Oberjoch, Kematsrieder Moor nordwestlich des Ortes, *Triebel 418*, Sept. 1983, [on *Hypogymnia physodes*]. – Oberbayern: Forstenrieder Park an der südlichen Stadtgrenze von München, *Triebel 48*, Feb. 1982, [on *Ramalina pollinaria*] – Forstenrieder Park an der südlichen Stadtgrenze von München, *Schwaiger 750*, Sept. 1985, [on *Hypogymnia physodes*] – Landkreis Eichstätt, Affental W bis

NW von Walting, *Triebel 1544 & Rambold*, Aug. 1985, [on *Ramalina pollinaria*] – Schlierseer Berge, Landkreis Rosenheim, zwischen Klamm-Alm und Asten (ca. 8 km NE Bayrischzell), *Wunder 3142*, Okt. 1985, [on *Parmelia sulcata*], accompanied by *Lichenopuccinia poeltii*, *Sclerococcum parmeliae*; separated, see also *Tremella hypogymniae*.

Lichenoconium lecanorae (Jaap) D.Hawksw.

Oberbayern: Landkreis Miesbach, Weidfilz c. 2.5 km W of Königsdorf, *Triebel & Rambold 5815*, July 1990, [on *Lecanora* spec.] – Forstenrieder Park südlich München, *Schwaiger 666*, Sept. 1985, [on *Lecanora conizaeoides*] – Landkreis Weilheim, Paterzeller Eibenwald N Paterzell, *Triebel 477*, Sept. 1984, [on *Lecanora albella*]. – Niederbayern: Bayerischer Wald, Landkreis Regen, Gipfel des Großen Falkensteins NE Zwiesel, *Schuhwerk 895/4b*, May 1989, [on *Lecanora* cf. *polytropa*]. – Two additional specimens from the surroundings of München; see also *Tremella hypogymniae*.

Lichenoconium pyxidatae (Oudem.) Petr. & Syd.

Oberbayern: Forstenrieder Park, südlich von München, *Schwaiger 938*, Sept. 1985, [on *Cladonia fimbriata*] – Forstenrieder Park, südlich von München, *Schwaiger 1282*, Oct. 1985, [on *Cladonia* cf. *digitata*] – Ammergauer Alpen, Friedergrieß etwa 1,5 km nordöstlich Griesen, *Döbbeler*, Sept. 1985, [on *Cladonia pyxidata* ssp. *pocillum*].

Lichenoconium usneae (Anzi) D.Hawksw.

Schwaben: Landkreis Füssen, Bleckenau am Weg zum Rothmoos, *Schröppel & Doppelbaur*, June 1963, sub *Coniothyrium usneae*, [on *Usnea* spec.]. – Oberbayern: Oberammergau, *Schnabl*, Aug. 1896, [on *Melanelia exasperata*], holotype of *Coniothyrium imbricariae* Allescher, det. D. Hawksworth, (ALLESCHER 1897: 18).

Lichenodiplis lecanorae (Vouaux) Dyko & D.Hawksw.

Oberbayern: Espen zwischen Roggenstein und Buchheim, München, *Arnold*, May 1896, sub *Tichothecium microcarpon*, [on *Caloplaca cerina*], rev. D. T. – An einem Lattenzaun in Untersendling, München, *Arnold*, Nov. 1890, sub *Tichothecium microcarpon*, [on *Caloplaca* spec.], rev. D. T.

****Lichenopeltella coppinsii*** Earland-Bennett & D.Hawksw.

Oberbayern: Kalkstein eines Steingerölles im Buchenwalde unterhalb Pullach, München, *Arnold*, Oct. 1888, sub *Arthopyrenia lichenum*, [on *Verrucaria* spec.], rev. D. T., (ARNOLD 1891: 131) – Kalksteine im Buchenwalde oberhalb Delling westlich von Weßling, München, *Arnold*, June 1889, sub *Arthopyrenia lichenum*, [on *Verrucaria muralis*], two specimens, rev. D. T., (ARNOLD 1891: 131) – Kalksteine im Buchenwalde oberhalb Delling bei Weßling, München, *Arnold*, June 1889, sub *Arthopyrenia lichenum*, [on *Verrucaria* spec.], rev. D. T., (ARNOLD 1891: 131) – Kalksteine des Waldweges zwischen dem Bahnwärterhaus und [dem Forsthaus] Wörnbrunn im Grünwalder Park, München, *Arnold*, April 1890, sub *Arthopyrenia lichenum*, [on *Verrucaria* spec.], rev. D. T.

****Lichenopeltella maculans*** (Zopf) Höhn.

Oberpfalz: Kleiner Osser über Lam, *Poelt*, June 1965, [on *Umbilicaria hirsuta*], conf. M. Matzer.

****Lichenopuccinia poeltii*** D.Hawksw. & Hafellner

Oberbayern: Schlierseer Berge, Landkreis Rosenheim, zwischen Klamm-Alm und Asten (ca. 8 km NE Bayrischzell), *Wunder 3142*, Okt. 1985, [on *Parmelia sulcata*], det. D. T., accompanied by *Lichenoconium erodens*, *Sclerococcum parmeliae*; separated.

Lichenosticta alcicorniaria (Linds.) D.Hawksw.

Oberbayern: München, Großhesselohe, *Schnabl*, 1894, [on *Cladonia fimbriata*], holotype of *Aposphaeria cladoniae*, det. D. L. Hawksworth, (ALLESCHER 1896: 32) – Landkreis Berchtesgadener Land, Gemeinde Ramsau, Nordseite des Hochkalter-Massivs, *Wunder 3990*, Aug. 1985, [on *Cladonia coniocraea*], det. J. Hafellner – Landkreis Berchtesgadener Land, Gemeinde Ramsau, zwischen Grieshütte und Wimbachschloß, *Wunder 3972*, Aug. 1985, [on *Cladonia* spec.], det. J. Hafellner – Berchtesgaden, Eckerfirst (Hoher Göll), *Schoenau*, Aug. 1920, [on *Cladonia digitata*], det. D. T.

****Lichenostigma cosmopolites*** Hafellner & Calatayud

Niederbayern: Bayrischer Wald, Umgebung von Regen, *Britzelmayr 551*, [no date], [on *Xanthoparmelia somloensis*], det. D. T. – Bayrischer Wald, without more definite locality data, *Gattinger*, Sept. 1846, [on *Xanthoparmelia somloensis*], det. D. T.

****Lichenostigma elongatum*** Nav.-Ros. & Hafellner

Unterfranken: Hammelburg, *Vill*, 1889, [on *Lobothallia radiosa*], det. D. T. – Hammelburg, *Vill*, May 1890, [on *Lobothallia radiosa*] – Mainfranken, Landkreis Gemünden, Kalkfelsen im Retzbachtal, *Klement 04843*, 1956, [on *Lobothallia radiosa*], det. D. T.

****Lichenostigma rugosum*** G.Thor

Schwaben: Allgäu, Landkreis Füssen, Illasberg bei Roßhaupten, *Klement*, 1952, [on *Diploschistes scruposus*], det. D. T. – Landkreis Füssen, Zell, auf Flyschsandstein im Moor zwischen Pfronten und Zell, *Schröppel*, May 1951, [on *Diploschistes scruposus*], det. D. T.

Marchandiomyces aurantiacus (Lasch) Diederich & Etayo

Oberfranken: Bayreuth, *de Thümen*, Mar. 1876, [on lichen indet.], conf. P. Diederich (cf.). – Oberbayern: Oberammergau, Dickelschwaige, *Allescher*, Sept. 1889, [on lichen indet.], conf. P. Diederich (cf.).

Marchandiomyces corallinus (Roberge) Diederich & D.Hawksw.

Oberbayern: Bei Großhessellohe, München, *Schnabl*, Sept. 1896, [on *Parmelia sulcata*], (ARNOLD 1897: 39), det. P. Diederich – Bei Großhessellohe, München, *Schnabl*, Sept. 1896 , [on *Melanelia* spec.], sub *Illosporium corallinum*, Arnold, Lich. Monac. Exs. 455, (ARNOLD 1897: 39), det. P. Diederich – Wasserburg am Inn, Innpromenade, *Schoenau*, Sept. 1942, sub *Illosporium roseum*, [on *Hypogymnia physodes*, *Parmelia sulcata*], det. P. Diederich.

Merismatium discrepans (J.Lahm) Triebel

A number of specimens from Bavaria in M are cited by TRIEBEL (1989: 194).

Merismatium peregrinum (Flot.) Triebel

Oberbayern: Amphibolitblock zwischen Buchhof und Haarkirchen, Starnberg, München, *Arnold*, Sept. 1895, [on *Rimularia badioatra*], det. D. T., (HERTEL & RAMBOLD 1990: 167) – Gneisblock im Walde links der Straße zwischen Percha und Neufahrn, Starnberg, München, *Arnold*, Sept. 1890, [on *Rimularia badioatra*], det. D. T., (HERTEL & RAMBOLD 1990: 167). – Niederbayern: Böhmerwald, Höllbachspreng am Falkenstein bei Zwiesel, *Schuhwerk 1121/1*, Apr. 1979, [on *Rimularia gibbosa*], det. D. T. – One additional specimen on *Rimularia gibbosa* in M is cited in HERTEL & RAMBOLD (1990: 172).

Merismatium scammoecum Lettau

Mittelfranken: Landkreis Hersbruck, Kalkfelsen oberhalb Enzendorf im Pegnitzthale, *Arnold*, July 1868, lectotype and isolectotype of *Polyblastia discrepans* f. *dilatata*. – For additional specimens from Bavaria in M see TRIEBEL (1989: 194).

Microcalicium arenarium (Hampe ex A.Massal.) Tibell

Oberfranken: Eckersdorfer Schlucht bei Bayreuth, *Arnold*, May 1861, sub *Cyphelium arenarium*, Arnold, Lich. Exs. Lich. Jur. 205, [on *Psilolechia lucida*] – Bayreuth, bei Eckersdorf, *Arnold*, [no date], [on *Psilolechia lucida*], (ARNOLD 1862: 306). – Niederbayern: Bayerisch-Böhmischer Wald, Landkreis Wolfstein, Lesesteinhaufen nördlich Grainet, *Poelt*, Aug. 1971, sub *Coniocybopsis arenaria*, [on *Psilolechia lucida*] – Bayerischer Wald, Landkreis Passau, im Gaißa-Tal, nahe Tiefenbach bei Passau, nördlich der Gaißa-Mühle, *Huber*, Apr. 1978, sub *Microcalicium arenicola*, Hertel, Lich. Alp. 322, [on *Psilolechia lucida*] – Bayerischer Wald bei Sankt Oswald, *Krempelhuber*, [no date], sub *Calicium citrinum*, [on *Psilolechia lucida*].

*****Minutoexcipula tuerkii*** Hafellner

Schwaben: Allgäuer Alpen, Schrecksee, *Grummann 4208 dupl.*, Aug. 1951, [on *Pertusaria glomerata*], det. D.T, accompanied by *Muellerella lichenicola*.

*****Monodictys cellulosa*** S.Hughes

Oberbayern: Berchtesgadener Land, S von Bad Reichenhall, Ramsau, knapp WNW der Mündung des Lattenbaches in die Ramsauer Ache, *Wittmann*, Mar. 1995, [on *Parmelina tiliacea*], det. D. T.

Muellerella lichenicola (Sommerf. ex Fr. : Fr.) D.Hawksw.

Oberfranken: Pottenstein in Oberfranken, *Wagner*, [no date], sub *Pharcidia*, [on *Caloplaca holocarpa* s.l.], rev. D. T. – Additional specimens from Bavaria in M are cited in TRIEBEL (1989: 158), see also *Minutoexcipula tuerkii*.

Muellerella pygmaea (Körb.) D.Hawksw. var. ***pygmaea***

Mittelfranken: Bei Dietenhofen in Franken, *Rehm*, [no date], [on *Lecidea fuscoatra* s.l.]. – Oberbayern: Dachziegel in Solndorf bei Feldkirchen, München, *Arnold*, July 1891, sub *Tichothecium pygmaeum*, [on *Lecidea fuscoatra*] – Landkreis Berchtesgadener Land, Gemeinde Schönau am Königssee, zwischen Jenner und Schneibsteinhaus, *Türk & Wunder*, Oct. 1984, [on *Caloplaca proteus*], at least three additional specimens on this host from the Bavarian Alps – Steinhaufen zwischen Dettenhausen und Egling, München, *Arnold*, July 1891, sub *Tichothecium pygmaeum*, [on *Lecidea fuscoatra*], four specimens from the same locality and host, one of this is Arnold, Lich. Monac. Exs. 201 (see also TRIEBEL 1989: 164).

Muellerella pygmaea var. ***athallina*** (Müll.Arg.) Triebel

Specimens from Bavaria in M are cited in TRIEBEL (1989: 170).

Muellerella pygmaea var. ***ventosicola*** (Mudd) Triebel

Oberbayern: Steinhaufen zwischen Dettenhausen und Egling, München, *Arnold*, Sept. 1890, sub *Tichothecium pygmaeum*, [on *Rhizocarpon distinctum*], three additional specimens from the same locality with different dates – Gneisstein im Waldgehänge südlich von Haarkirchen, München, *Arnold*, Sept. 1890, sub *Tichothecium pygmaeum*, [on *Rhizocarpon reductum*].

Nectriopsis lecanodes (Ces.) Diederich & Schroers

Mittelfranken: Waldgraben bei Ezelheim in Franken, *Rehm*, Oct. 1869, Rehm, Ascomyc. 38, with *Scutula dedicata* (*Karsteniomyces*-state).

*****Nectriopsis parmeliae*** (Berk. & M.A.Curtis) M.S.Cole & D.Hawksw.

Schwaben: Pfronten, *Rueß*, Nov. 1897, sub *Pleonectria lichenicola*, [on *Physcia stellaris*], rev. D. T.

Opegrapha physciaria (Nyl.) D.Hawksw. & Coppins

Mittelfranken: Bei Obernesselbach in Franken, *Rehm*, 1867, sub *Celidium varium*, Rabenhorst, Lich. Europ. Exs. 785, [on *Xanthoria parietina*], with *Xanthoriicola physciae*, (ARNOLD 1885: 221) – In Laubwäldern bei Sugenheim in Franken, *Rehm*, Nov. 1866, sub *Celidium varium*, Arnold, Lich. Exs. Lich. Jur. 335, [on *Xanthoria parietina*], with *Xanthoriicola physciae*, (ARNOLD 1885: 221). – Oberbayern: Auf Buchen am Waldsaume ober den Anlagen bei Eichstätt, *Arnold*, Oct. 1868, sub *Celidium varium*, Arnold, Lich. Exs. Lich. Jur. 335b, [on *Xanthoria parietina*], mostly *Xanthoriicola physciae*, (ARNOLD 1868: 523, 1885: 221). – Two further specimens from the same localities in M.

Opegrapha pulvinata Rehm

Oberbayern: Chiemgauer Alpen, Weitalm am Hochgern, *Steiner*, Aug. 1950, [on *Dermatocarpon miniatum*] – Kalkblöcke zwischen Taubensee und Rauher Nadel, Bayerische Alpen, *Arnold*, Sept. 1872, [on *Dermatocarpon* spec.].

Opegrapha rupestris Pers.

A large number of specimens from Bavaria is kept in the lichen herbarium. The following three specimens from Bavaria have been distributed in exsiccatae.

Oberfranken: Zwischen Tüchersfeld und Pottenstein in Oberfranken, *Arnold*, [no date], sub *Opegrapha saxicola*, Rabenhorst, Lich. Europ. Exs. 334. – Oberbayern: Chiemseer Berge, zwischen Karkopf und Hochries südlich oberhalb Grainbach, *Hertel*, Aug. 1974, sub *Opegrapha saxicola*, Hertel, Lich. Alp. 331 – Im Laubwalde der Anlagen bei Eichstätt, *Arnold*, Aug. 1864, Arnold, Lich. Exs. Lich. Jur. 286, (ARNOLD 1884: 661).

Opegrapha zwackhii (A.Massal. ex Zwackh) Källsten

Oberfranken: Oberfranken, Schönfeld, *Kaiser*, [no date], [on *Phlyctis argena*], det. B. J. Coppins.

Phacopsis oxyspora (Tul.) Triebel & Rambold var. ***oxyspora***

Oberbayern: Im Walde vor der Vorderen Oesteralpe bei Partenkirchen, *Arnold*, Aug. 1875, [on *Platismatia glauca*]. – For a second specimen from Bavaria see under *Abrothallus parmeliarum*; see also ARNOLD (1897: 38).

Phacopsis oxyspora var. ***fusca*** Triebel & Rambold

Two specimens from Bavaria in M; see TRIEBEL et al. (1995: 80).

Phacopsis vulpina Tul.

Oberbayern: Berchtesgaden, Funtensee und Feldalmgrube, *Rauchenberger*, [no date], [on *Letharia vulpina*], (KREMPELHUBER 1861: 275) – Funtenseetauern, *Sendtner*, 1856, [on *Letharia vulpina*], det. D. T.

Phaeopyxis punctum (A.Massal.) Rambold, Triebel & Coppins

Oberfranken: Keuperregion bei Bayreuth, *Walther*, Feb. 1863, sub *Nesolechia punctum*, Arnold, Lich. Exs. Lich. Jur. 252, [on *Cladonia* spec.]. – This and additional specimens from Bavaria in M see RAMBOLD & TRIEBEL (1990: 385).

Phaeospora parasitica (Lönnr.) Arnold

Oberbayern: Landkreis Bad Tölz-Wolfratshausen, im Lainbachtal südöstlich Benediktbeuren, *Feuerer 12354a, 12354c*, Aug. 1982, [on *Rhizocarpon umbilicatum*], two specimens – Landkreis Miesbach, Wendelstein, Nordseite kurz unterhalb des Gipfels, *Feuerer 1155*, Aug. 1982, [on *Rhizocarpon umbilicatum*].

Phaeospora rimosicola (Leight. ex Mudd) Hepp

Oberfranken: Oberhalb Pottenstein in Oberfranken, *Wagner*, Sept. 1867, sub *Xenosphaeria rimosicola*, Arnold, Lich. Exs. Lich. Jur. 379, [on *Rhizocarpon petraeum*], two specimens (ARNOLD 1885: 224). – Schwaben: Landkreis Oberallgäu, Hochgrat am Weg zum Rindalphorn, *Feuerer 11847 & Höhne*, May 1982, sub *Phaeospora parasitica*, [on *Rhizocarpon petraeum*]. – Oberbayern: Auf dem Hochgern ober Wessen in den bayerischen Alpen, *Arnold*, Aug. 1869, [on *Rhizocarpon petraeum*], (ARNOLD 1870b: 236) – Begraster Abhang, Westseite des Blombergs bei Tölz, *Arnold*, Aug. 1881, sub *Phaeospora rimosicola*, Arnold, Lich. Exs. Lich. Jur. 379b, [on *Rhizocarpon* cf. *subconcentricum*]. – A number of additional specimens from Bavaria in M.

Phaeosporobolus usneae D.Hawksw. & Hafellner

Oberbayern: Nationalpark Berchtesgaden, Watzmannmassiv, ca. 200 m nordwestlich der Klimastation oberhalb der Mitterkaseralm, *Hadatsch* 66, Sept. 1991, [on *Usnea subfloridana* (det. R. Türk)], det. D. T. – Nationalpark Berchtesgaden, Steinernes Meer, Stuhlgrabenkogel, *Wunder 4139 & Türk*, Sept. 1985, [on *Letharia vulpina*], det. D. T. – Berchtesgadener Alpen, über dem Funtensee, *Poelt*, Sept. 1948, [on *Letharia vulpina*], det. D. T. – Im Karolinengeräumt im Forstenrieder Park, München, *Arnold*, Sept. 1890, [on *Usnea subfloridana* (det. P. Clerc)], det. D. T. – Ammergauer Alpen, Weg von der Notkarspitze nach Farchant, *Poelt*, Oct. 1977, [on *Usnea* spec.], det. D. T. – See also *Phoma cytospora*.

****Phoma cytospora*** (Vouaux) D.Hawksw.

Schwaben: Allgäu, Pfronten, Hochalm, *Schröppel*, Nov. 1954, [on *Parmelia saxatilis*], accompanied by *Phaeosporobolus usneae*, det. D. T.

*****Phoma denigricans*** Hafellner

Oberbayern: Alpspitze, *Krempelhuber*, 1846, [on *Lecanora epibryon*], det. D. T. – Watzmann, *Krempelhuber*, 1855, [on *Lecanora epibryon*], det. D. T. – Nationalpark Berchtesgaden, Steinernes Meer, Viehkogel, Gipfel, *Wunder & Türk*, Sept. 1985, [on *Lecanora epibryon*], det. D. T.

Phyllosticta lichenicola Allescher

Oberbayern: München, Ebenhausen, April 1895, *Schnabl*, [on *Parmotrema chinense*], holotype, (ALLESCHER 1896: 32, ARNOLD 1897: 39, HAWKSWORTH 1981: 83 "nomen ambiguum").

Plectocarpon lichenum (Sommerf.) D.Hawksw.

Unterfranken: Bei Ruppertshütten (Lohr) im Spessart, *Rehm*, July 1877, sub *Celidium stictarum*, Rehm, Ascomyc. 424, [on *Lobaria pulmonaria*]. – Oberfranken: Bei Waldstein im Fichtelgebirge, *Laurer*, [no date], sub *Celidium stictarum*, Hepp, Flechten Europ. 590, [on *Lobaria pulmonaria*]. – Oberbayern: Lauterbachthal bei Kreuth, *Kühn*, Sept. 1872, sub *Celidium stictarum*, Rabenhorst, Fungi Europ. Exs. 1648, [on *Lobaria pulmonaria*] – Bei Raitenbuch, Eichstätt in Bayern, *Arnold*, 1862, sub *Celidium stictarum*, Rabenhorst, Lich. Europ. Exs. 657, [on *Lobaria pulmonaria*], (ARNOLD 1885: 221). – A number of additional specimens from Bavaria collected in the 19th century, but only four specimens collected in the 20th century in M; see also ARNOLD (1897: 38).

Polycoccum arnoldii (Hepp) D.Hawksw.

Oberfranken: Auf steinigem Boden des Brand bei Hetzelsdorf in Oberfranken, 1857, [on *Diploschistes muscorum*], (ARNOLD 1858: 702, KREMPELHUBER 1861: 276). – Oberbayern: Auf steinigem Boden, zwischen Winterhof u. Ruppertsbuch, bei Eichstätt, *Arnold*, [no date], sub *Phaeospora* (*Sphaeria*?) *arnoldi*, Hepp, Flechten Europ. 701, [on *Diploschistes muscorum*], two isotypes, (ARNOLD 1858: 702) [The host is originally given as "*Urceolaria scruposa* f. *iridata*". This is a synonym of *Diploschistes muscorum*, see LUMBSCH (1987: 604)] – Auf Erde, kahle Bergeshöhen bei Eichstätt, *Arnold*, 1856, [on *Diploschistes muscorum*], (ARNOLD 1858: 702) – Kahle Bergeshöhen bei Eichstätt, *Arnold*, 1857, [on *Diploschistes muscorum*], (ARNOLD 1858: 702) – Steiniger Boden bei Nassenfels unweit Eichstätt, *Arnold*, Oct. 1858, [on *Diploschistes muscorum*], (ARNOLD 1858: 702, KREMPELHUBER 1861: 276). – Two additional specimens in M.

Polycoccum cladoniae Diederich & D.Hawksw.

Oberbayern: Rottach b. Tegernsee, ?*Krempelhuber*, Oct. 1859, [on *Cladonia digitata*], det. D. T. – Berchtesgaden, Wimbachtal, Schneelahnerwald, *Schoenau*, Aug. 1929, [on *Cladonia digitata*], det. D. T.

Polycoccum marmoratum (Kremp.) D.Hawksw.

Oberfranken: Kalkfelsen ober der Oberfellndorfer Straße bei Streitberg, *Arnold*, July 1868. – Oberbayern: Kalkfelsen bei Hüting, Eichstätt, *Arnold*, Aug. 1860, 3 syntypes of *Tichothecium marmoratum*, (ARNOLD 1861: 265) – Dolomit unterhalb der Römerschanze zwischen Piesenhard und der Feldmühle bei Eichstätt, *Arnold*, 1860, syntype of *Tichothecium marmoratum*, (ARNOLD 1861: 265) – Kalkfelsenwand gegenüber Kunstein bei Eichstätt, *Arnold*, June 1862, sub ?*Tichothecium marmoratum*, Arnold, Lich. Exs. Lich. Jur. 246 – Kalksteine im Walde des Arzberges ober Beilngries im Altmühltal, *Arnold*, 1867 – Kalkfelsen am Ufer des Taubensees ober Wessen in den bayerischen Alpen, *Arnold*, Sept. 1868, (ARNOLD 1869: 268). – A number of additional specimens collected by F. Arnold mostly in the surroundings of Eichstätt in M (see also ARNOLD 1861: 265, 1885: 157).

Polycoccum microsticticum (Leight. ex Mudd) Arnold

Oberbayern: Steinhaufen zwischen Dettenhausen und Egling, München, *Arnold*, July 1891, sub *Polycoccum microsticticum*, Arnold, Lich. Monac. Exs. 200a, [on *Acarospora fuscata*], the specimen in M has also *Carbonea vitellinaria* on *Candelariella vitellina*, another specimen from the same locality was collected by F. Arnold in Sept. 1890, (ARNOLD 1891: 132, 1892: 26) – Steinhaufen zwischen Deining und Egling, München, *Arnold*, Aug. 1888, [on *Acarospora fuscata*], one additional specimen with similar locality data in M.

****Polycoccum sporastatiae*** (Anzi) Arnold

Schwaben: Gaultsandsteinfelsen der oberen Hochalpe der Gottesackerwände im Allgäu, *Rehm*, 1860, [on *Sporastatia testudinea*], det. D. T. – Hochalpe im Allgäu, *Rehm*, 1860, [on *Sporastatia testudinea*], det. D. T.

Pronectria robergei (Mont. & Desm.) Lowen

Mittelfranken: Waldgraben bei Ezelheim in Franken, *Rehm*, Oct. 1869, sub *Nectriella robergei*, Rehm, Ascomyc. 37, [on *Peltigera rufescens*], det. R. Santesson. – Oberbayern: Schöngeising, *Lederer*, Sept. 1894, sub *Nectria lichenicola*, [on *Peltigera didactyla*] – Am Saume des Buchenwaldes zwischen Schöngeising und dem Jexhof, München, *Arnold*, June 1894, sub *Nectria lichenicola*, Arnold, Lich. Monac. Exs. 373, [on *Peltigera didactyla*], det. R. Santesson, two specimens of this exsiccata and one additional specimen from the same locality (ARNOLD 1897: 39).

Pyrenidium actinellum Nyl.

Schwaben: Obermädeli-Alpe, Allgäu, Schwarze Milz [borderland to Austria, Tirol], *Rehm* [on *Solorina crocea*], det. D. T. – Oberbayern: zwischen Buchendorf und Leutstetten, München, *Arnold*, 1892, sub *Phaeospora granulosae*, Arnold, Lich. Exs. 1564, [on *Trapeliopsis granulosa*], holotype, (ARNOLD 1897: 39, TRIEBEL 1989: 68) – Buchendorfer Gemeindewald, München, *Arnold*, 1892, sub *Phaeospora granulosae*, [on *Trapeliopsis granulosa*], (ARNOLD 1897: 39, TRIEBEL 1989: 70).

****Sclerococcum parmeliae*** Etayo & Diederich

Schwaben: Allgäu, Hohen Schwangau, in der Blockenau, *Schröppel*, Okt. 1954, [on *Parmelia saxatilis*], det. D. T. – Oberbayern: Schlierseer Berge, Landkreis Rosenheim, zwischen Klamm-Alm und Asten (ca. 8 km NE Bayrischzell), *Wunder 3142*, Okt. 1985, [on *Parmelia sulcata*], det. D. T., accompanied by *Lichenoconium erodens*, *Lichenopuccinia poeltii*; separated.

Sclerococcum sphaerale (Ach.) Fr. : Fr.

Oberfranken: Auf Granit auf dem Schneeberge im Fichtelgebirge, *Gümbel*, 1860, sub *Cyphelium corallinum*, [on *Pertusaria corallina*]. – Mittelfranken: Auf Keupersandsteinfelsen im Rügländer Thale bei Adelmannsdorf (Dietenhofen) in Franken, *Rehm*, 1855, sub *Cyphelium corallinum*, [on *Pertusaria corallina*]. – Oberpfalz: Oberpfälzer Wald, Landkreis Neunburg v. W., Gneisblöcke im Blockgewirr bei Warnthal, *Poelt*, May 1965, [on *Pertusaria corallina*]. – Niederbayern: Böhmerwald, Gipfel des Großen Rachel bei Zwiesel, *C. & J. Poelt & Ullrich*, Sept. 1963, sub *Coniothecium pertusariicola*, [on *Pertusaria corallina*], rev. D. T.

Scutula dedicata Triebel, Wedin & Rambold

A number of specimens from Bavaria in M; see TRIEBEL et al. (1997: 327).

Scutula epiblastematica (Tul.) Rehm

See TRIEBEL et al. (1997: 330).

Scutula heeri (Hepp) Trevis.

See TRIEBEL et al. (1997: 332).

Scutula krempelhuberi Körb.

Oberbayern: Berchtesgaden, *Krempelhuber*, 1854, [on *Solorina saccata*]. – Two additional collections on *Solorina* might belong to this species, WEDIN & TRIEBEL (in prep.).

Scutula miliaris (Wallr.) Trevis.

See TRIEBEL et al. (1997: 336).

****Skyttea cismonicae*** Hafellner

Oberbayern: Zwischen Vordergraseck und dem Eckbauern bei Partenkirchen in Südbayern, *Arnold*, Sept. 1874, [on *Loxospora cismonica*]. Host lichen distributed sub *Haematomma cismonicum*, Arnold, Lich. Exs. Lich. Jur. 141b. Lichenicolous fungus separated, det. P. Diederich & D. T.

****Sphaerellothecium minutum*** Hafellner

Oberpfalz: Ossa [= Osser], *Lederer*, 1893, [on *Sphaerophorus fragilis*], det. D. T. – Niederbayern/Oberpfalz: Arber, *Lederer*, 1892, [on *Sphaerophorus fragilis*], det. D. T.

Sphaerellothecium propinquellum (Nyl.) Cl.Roux & Triebel

Three specimens from Bavaria in M; see ROUX & TRIEBEL (1994: 531).

Sphinctrina anglica Nyl.

Schwaben: Nebelhornbahn bei Oberstdorf, Allgäu, *Schauer*, Oct. 1962, sub *Sphinctrina microcephala*, conf. O. Löfgren. – Oberbayern: Holzapfelskreuth, *Lederer*, 1892, sub *Sphinctrina microcephala*, conf. O. Löfgren – Bei Eichstätt, *Arnold*, 1862, sub *Sphinctrina microcephala*, Arnold, Lich. Exs. Lich. Jur. 245, conf. O. Löfgren, two specimens of this exsiccata, (ARNOLD 1885: 61) – Östlich Großhadern, München, *Arnold*, 1862, sub *Sphinctrina microcephala*, Arnold, Lich. Monac. Exs. 193, conf. O. Löfgren, two specimens of this exsiccata. – A number of additional specimens from Bavaria in M; see also ARNOLD (1862: 395) and HERTEL et al. (2001).

Sphinctrina turbinata (Pers. : Fr.) De Not.

Mittelfranken: Dietenhofen, *Rehm*, 1855, [on *Pertusaria pertusa*], conf. O. Löfgren, (KREMPELHUBER 1861: 273). – Oberbayern: Forstenrieder Park südlich München, *Schwaiger 1467*, May 1986, [on *Pertusaria coccodes*] – Zwischen Schloß Pähl und Kerschlach, Oberbayern, *Poelt*, June 1957, sub *Sphinctrina gelasinata*, [on *Pertusaria coronata*], conf. O. Löfgren – Bei Gauting, München, *Hiendlmayr*, Aug. 1864, sub *Calycium turbinatum*, [on *Pertusaria pertusa*], conf. O.

Löfgren. – A number of additional specimens from Bavaria in M; see also ARNOLD (1858: 700, 1885: 61, 1897: 32) and HERTEL et al. (2001).

****Stigmidium bellemerei** Cl.Roux & Nav.-Ros.

Oberpfalz: Ruine Ehrenfels bei Beratzhausen in der Oberpfalz, *Arnold*, Sept. 1879, sub *Arthopyrenia lichenum*, Arnold, Lich. Exs. 820, [on *Lecania suavis*], det. D. T.

Stigmidium cerinae Cl.Roux & Triebel

Schwaben: Allgäu, Aggenstein-Gipfel, *Klement*, 1952, [on *Caloplaca cerina* var. *chloroleuca*], (ROUX & TRIEBEL 1994: 481).

Stigmidium congestum (Körb.) Triebel

Six specimens from Bavaria in M; see ROUX & TRIEBEL (1994: 486).

Stigmidium fuscatae (Arnold) R.Sant.

Mittelfranken: Brauner Jura eines Steinbruchs nördlich von Treuchtlingen, Eichstätt, *Arnold*, Apr. 1870, [on *Acarospora fuscata*], holotype, (ARNOLD 1872: 572, 1874a: 174, 1885: 223). – Oberpfalz: Brauner Jura des Erzberges bei Amberg, *Arnold*, Sept. 1861, [on *Acarospora fuscata*], two specimens, (ARNOLD 1872: 572, 1885: 223) – Brauner Jura auf dem Erzberge bei Amberg, *Arnold*, 1862, [on *Acarospora fuscata*], (ARNOLD 1872: 572, 1885: 223).

Stigmidium hageniae (Rehm) Hafellner

Mittelfranken: Bei Obernesselbach in Franken, *Rehm*, 1870, sub *Sphärella hageniae*, Rehm, Ascomyc. 32, [on *Anaptychia ciliaris*], isotype – Bei Obernesselbach in Franken, *Rehm*, 1870, [on *Anaptychia ciliaris*] – Bei Sugenheim in Franken, *Rehm*, 1868, sub *Pharcidia hageniae*, Arnold, Lich. Exs. Lich. Jur. 398, [on *Anaptychia ciliaris*].

Stigmidium lichenum (Arnold) Triebel & P.Scholz, comb. nov.

Bas. *Arthopyrenia lichenum* Arnold, Flora 59: 567 (1876)

Pharcidia lichenum Arnold, Flora 55: 572 (1872) – not val. publ. (ICBN Art. 52.1 – superflous)

Pharcidia lichenum Arnold, Verh. K.K. Zool.-Bot. Ges Wien 22: 302 (1872) – not val. publ. (ICBN Art. 32.1 – without descr.)

Pharcidia lichenum (Arnold) Arnold ex G.Winter, Rabenh. Kryptog.-Flora Deutschl., 2. Aufl., Pilze 1(2): 343–344 (1885) (ICBN Art. 33.3 ex 7 – valid comb.)

Oberbayern: Ober Wasserzell bei Eichstätt, *Arnold*, Apr. 1876, sub *Arthopyrenia lichenum*, Arnold, Lich. Exs. Lich. Jur. 692a, [on *Verrucaria maculiformis*], **lectotype** and **isolectotype** designated here (ARNOLD 1876: 567, 1885: 222) – Kalksteine ober Wasserzell, Eichstätt, *Arnold*, 1876, sub *Arthopyrenia lichenum*, (ARNOLD 1876: 567, 1885: 222) – Auf Solnhofer Schieferplatten bei Eichstätt, *Arnold*, May 1886, sub *Pharcidia lichenum*, Rehm, Ascomyc. 893 – Oberhalb Wasserzell bei Eichstätt, *Arnold*, May 1886, sub *Arthopyrenia lichenum*, Arnold, Lich. Exs. Lich. Jur. 692b, (ARNOLD 1885: 222). – A number of additional specimens collected by F. Arnold in M.

****Stigmidium mycobilimbiae** Cl.Roux, Triebel & Etayo

Oberbayern: Kalkhornsteinwand auf dem Hochgern in den Bayerischen Alpen, *Arnold*, Aug. 1869, [on *Mycobilimbia accedens*], det. D. T.

Stigmidium psorae (Anzi) Hafellner

Oberbayern: Berchtesgaden, Steinernes Meer, bei der Schönbichlalpe, *Schönau*, Aug. 1929, [on *Psora decipiens*], (TRIEBEL 1989: 84).

Stigmidium rivulorum (Kernst.) Cl.Roux & Nav.-Ros.

Oberbayern: Kalk-Glimmersteine im Bache östlich beim chinesischen Turm, München, *Arnold*, July 1897, [on *Verrucaria aquatilis*], (ARNOLD 1901: 13) – Kalksteine im Bache beim chinesischen Turm im englischen Garten, München, *Arnold*, July 1897, sub *Arthopyrenia rivulorum*, Arnold, Lich. Monac. Exs. 486b, [on *Verrucaria aquatilis*], (ARNOLD 1901: 13) – Steine im Bache beim chinesischen Turm im englischen Garten, München, *Arnold*, Sept. 1897, sub *Arthopyrenia rivulorum*, Arnold, Lich. exs. 1566b, [on *Verrucaria aquatilis*], (ARNOLD 1901: 13).

Stigmidium schaereri (A.Massal.) Trevis.

Three specimens from Bavaria in M; see ROUX & TRIEBEL (1994: 507).

****Stigmidium squamariae*** (de Lesd.) Cl.Roux & Triebel

Schwaben: Allgäu, Lkrs. Füssen, Pfronten, im Aachtal unterhalb des Kienberges, *Schröppel*, June 1953, [on *Lecanora muralis*], det. D. T. – Allgäu, Lkrs. Füssen, Zell, Moor am Sulzbach, *Schröppel*, Aug. 1951, [on *Lecanora muralis*], occuring together with *Cercidospora macrospora*, det. D. T.

Stigmidium tabacinae (Arnold) Triebel

Syn. *Stigmidium glebarum* (Arnold) Hafellner

Oberfranken: Dolomitfelsen ober der Waidmannsgeseeser-Schlucht bei Pottenstein in Oberfranken, *Arnold*, Sept. 1886, sub *Arthopyrenia glebarum* on *Thalloid. caeruleonigric.*, Arnold, Lich. Exs. 1196, [on *Toninia physaroides*], holotype and isotype of *Stigmidium glebarum*.

****Syzygospora physciacearum*** Diederich

Oberbayern: Isaranlagen gegen Thalkirchen, *Allescher*, Nov. 1878, sub *Illosporium roseum*, [on *Physcia tenella*], det. P. Diederich.

****Taeniolella punctata*** M.S.Christ. & D.Hawksw.

Schwaben: Günzburg/ Donau, Donauauen "Leibi", *Doppelbaur F 46*, March 1963, [on *Graphis scripta*], det. D. T. – Oberbayern: Menterschwaige bei München, *Krempelhuber*, 1959, [on *Graphis scripta*], det. D. T.

Taeniolina scripta (P.Karst.) P.M.Kirk

Oberbayern: Oberschleißheim, nördlich München, Naturwaldreservat Fasanerie, Korbiniani-Hölzl, *Hadatsch*, Sept. 1990, [on *Lepraria incana*], det. D. T.

Thelocarpon lichenicola (Fuckel) Poelt & Hafellner

Oberfranken: An Sandsteinen des braunen Jura in einem Waldhohlwege am Wege von Banz nach Altenbanz in Oberfranken, *Arnold*, Sept. 1882, sub *Thelocarpon excavatulum*, Arnold, Lich. Exs. 960, isotype, (ARNOLD 1885: 167), det./conf. G. Salisbury 1972, J. Kocourková-Horáková 1997 – An Sandsteinen des braunen Jura, Waldhohlwege bei Schloß Banz in Oberfranken, *Arnold*, Sept. 1882, sub *Thelocarpon excavatulum*, Arnold, Lich. Exs. 960, ? holotype, det./conf. J. Kocourková-Horáková 1997. (The label of this specimen is handwritten with drawings of F. Arnold in contrast to the same number of this exsiccata cited above). – Oberfranken: Sandsteine beim Schutzengelsteinbruch im Veldensteiner Forste, Neuhaus, Oberpfalz, *Arnold*, [no date], det. J. Kocourková-Horáková 1997.

Tremella coppinsii Diederich & G.Marson

Oberbayern: Tal des Schwarzbaches zwischen dem Wirtshaus Wachterl und Kaltbach, ca. 10,5 km südlich von Bad Reichenhall, Berchtesgadener Land, *Wittmann*, Feb. 1995, [on *Platismatia glauca*].

Tremella hypogymniae Diederich & M.S.Christ.

Schwaben: Landkreis Sonthofen, 6,5 km SE of Oberstaufen, along trail below Spitzlerberg, at the right side of the creek Weißach between lower station of the Hochgratbahn and crossing with trail to Lanzenbach, *Triebel & Rambold 5934*, May 1991, [on *Hypogymnia physodes*], with *Lichenoconium lecanorae* and *L. erodens* on *Tremella hypogymniae*, (DIEDERICH 1996: 94), det. P. Diederich.

Vouauxiella lichenicola (Linds.) Petr. & Syd.

Schwaben: Allgäuer Alpen, Landkreis Oberallgäu, Hindelang, Oberjoch, Straßenrand westlich des Kematsrieder Moores, *Triebel 405*, Sept. 1983, [on *Lecanora chlarotera*]. – Oberbayern: Landkreis Eichstätt, Walnußbaumallee beim Ziegelhof ca. 2 km NE Eichstätt, *Triebel & Rambold 1532*, Aug. 1985, [on *Lecanora chlarotera*] – Biehl bei Benedictbeuern, an der Straße von Kimsee, *Allescher*, Sept. 1885, sub *Pharcidia epicymatia*, [on *Lecanora chlarotera*], vid. C. Roux – Am nördlichen Waldrande zwischen Obersradling und Großhesselohe, *Boll*, Feb. 1889, sub *Pharcidia congesta*, [on *Lecanora chlarotera*], vid. C. Roux – Bei Ebenhausen, München, *Arnold*, May 1894 [on *Lecanora* cf. *carpinea*], (ARNOLD 1897: 38), growing together with *Arthonia subvarians*. – Niederbayern: Bayerischer Wald, am Helmberg südöstlich Münster bei Straubing, *Poelt*, June 1965, [on *Lecanora chlarotera*], growing together with *Stigmidium congestum*. – See also ROUX & TRIEBEL (1994: 486).

Vouauxiella verrucosa (Vouaux) Petr. & Syd.

Oberbayern: Südbayern, Petershausen, nördlich des Gehöfts Weingarten, *Rambold 760*, June 1982, [on *Lecanora chlarotera*] – Berchtesgadener Land, zwischen Hinterbrand und Vorderbrand, *Wunder 2057*, Aug. 1983, [on *Lecanora chlarotera*], det. D. T. (cf.).

****Vouauxiomyces ramalinae*** (Nordin) D.Hawksw.

Oberbayern: Forstenrieder Park südlich München, *Schwaiger 782*, Sept. 1985, [on *Ramalina* spec.], det. D. T.

Vouauxiomyces truncatus (de Lesd.) Dyko & D.Hawksw.

Oberbayern: Forstenrieder Park südlich München, *Schwaiger 1454, 1466*, May 1986, [on *Flavoparmelia caperata*], one additional collection from Forstenrieder Park 1986 – Forstenrieder Park, *Arnold*, June 1895, [on *Flavoparmelia caperata*] – Uferpromenade von St. Bartholomä am Königssee, Berchtesgadener Land, *Wunder 2235*, Apr. 1984, [on *Flavoparmelia caperata*].

Xanthoriicola physciae (Kalchbr.) D.Hawksw.

Schwaben: Ammergauer Alpen, Landkreis Füssen, südlich Buching, *Schröppel & Poelt*, Mar. 1963, sub *Coniosporium physciae*, Poelt & Steiner, Lich. Alp. 198, [on *Xanthoria parietina*]. – Oberbayern: Bei Großhesselohe, München, *Schnabl*, Sept. 1896, sub *Coniosporium physciae*, Arnold, Lich. Monac. Exs. 454, [on *Xanthoria parietina*], two specimens of this exsiccata, (ARNOLD 1897: 39), conf. T. Feuerer – Landkreis Erding, c. 4 km SSE of Moosburg, parking lot of the motor highway E 53 (A 92), *Rambold*, Mar. 1998, sub *Xanthoriicola physciae*, Triebel, Microf. Exs. 350, [on *Xanthoria parietina*] – Landkreis Landsberg am Lech, Pappelallee nördlich Schwifting, *Feuerer 2736*, Mar. 1979, [on *Xanthoria parietina*]. – A number of additional specimens from Upper Bavaria in M, see map in FEUERER & HÖHNE (1980: 132).

Xenonectriella lutescens (Rehm) Weese

Oberpfalz: Straßenböschung des Kreuzbergs zwischen Hahnbach und Vilseck in der Oberpfalz, *Arnold*, Sept. 1882, sub *Pleonectria lutescens*, Arnold, Lich. Exs. 963, [on *Solorina saccata*], (ARNOLD 1885: 222) – Kreuzberg bei Vilseck, Oberpfalz, *Arnold*, Sept. 1882, sub *Nectria lutescens*, Rehm, Ascomyc. 681, [on *Solorina saccata*], isolectotype and one additional specimen from the same locality, (ARNOLD 1885: 222).

Zwackhiomyces dispersus (J.Lahm ex Körb.) Triebel & Grube
Oberbayern: Am Waldfußweg unterhalb Grünwald, München, *Arnold*, May 1889, sub *Cercidospora*, [on *Protoblastenia rupestris*], (TRIEBEL 1989: 120).

Zwackhiomyces immersae (Arnold) Grube & Triebel
Oberbayern: Südbayern, Werdenfelser Land, Umgebung Garmisch-Partenkirchen, Partnachklamm, unteres Ende der Schlucht, *Rambold*, July 1983, [on *Clauzadea monticola*], (TRIEBEL 1989: 120).

****Zwackhiomyces inconspicuus*** Grube & Hafellner
Mittelfranken: Sugenheim in Franken, *Rehm*, 1867, sub *Arthopyrenia aspiciliae*, [on *Lecanora dispersa*], rev. D. T.

Appendix

Two specimens of *Chaenothecopsis rubescens* housed in the lichen collection in M are cited here. This is in addition to SCHMIDT (1970: 147) who notifies the occurence of this species in Bavaria without citing any locality.

Chaenothecopsis rubescens Vain.
Unterfranken: Haßfurt, in der Altach an einer Eiche, *Vill*, 1894, sub *Calycium parietinum*, det. A. Schmidt 1984. – Oberbayern: Alte Eiche im Wald der Donau-Auen zwischen Gerolfing und Dünzelau bei Ingolstadt, *Arnold*, May 1867, det. A. Schmidt 1969.

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– 1862b: Die Lichenen des fränkischen Jura. (Schluss.). – Flora 45: 385–396.
– 1865: Die Lichenen des fränkischen Jura. – Flora 48: 596–599.
– 1868: Die Lichenen des fränkischen Jura. – Flora 51: 520–524.
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Dr. Dagmar TRIEBEL, Botanische Staatssammlung München, Menzinger Strasse 67, D-80638 München, Germany.
E-mail: triebel@botanik.biologie.uni-muenchen.de

Dr. Peter SCHOLZ, Paetzstr. 37, D-04435 Schkeuditz, Germany.
E-mail: UfU.Bioindikation@t-online.de

Taxonomic Revision of *Astragalus* sect. *Acanthophace* (Fabaceae)

Sh. ZARRE & D. PODLECH

Abstract:
ZARRE, SH. & PODLECH, D.: Taxonomic Revision of *Astragalus* sect. *Acanthophace* (Fabaceae). – Sendtnera 7: 233–251. 2001. ISSN 0944–0178.

Sect. *Acanthophace* Bunge of the genus *Astragalus* L. is revised taxonomically. The newly described sect. *Lamprocarpa* Maassoumi is reduced to synonymy under sect. *Acanthophace*. The systematic position of *Astragalus pseudoangustifolius* Sirj. & Rech.f. and *A. cryptocarpus* DC. is clarified through selection of epitypes. *A. cystosus* Zarre & Podlech and *A. hezarensis* Zarre & Podlech are described as new species here for the first time.

Zusammenfassung:
Eine Revision von *Astragalus* L. sect. *Acanthophace* Bunge wird vorgelegt. Die erst kürzlich beschriebene Sekt. *Lamprocarpa* Maassoumi wird als Synonym zu *Acanthophace* gestellt. Die systematische Position von *A. pseudoangustifolius* Sirj. & Rech.f. und *A. cryptocarpus* DC. wird durch die Wahl von Epitypen fixiert. *A. cystosus* Zarre & Podlech und *A. hezarensis* Zarre & Podlech werden als neue Arten beschrieben.

Introduction

Sect. *Acanthophace* Bunge is revised here in the frame work of preparing a treatment of the thorny *Astragalus* groups for the Flora Iranica. A complete revision of this section and sect. *Aegacantha* Bunge was published by I. DEML in 1972. However, due to the poor availibility of material to the author at the time and the unclear borders between the sections of the thorny *Astragali*, her work was a preliminary one and it was necessary to revise the section again. In the famous work of BUNGE (1868/1869) this section was classified under subgen. *Phaca* Bunge, characterized by large pods rupturing the calyx. The current systematic position of sect. *Acanthophace* is, however, within subgen. *Astragalus* (see PODLECH 1982). It has been shown that this section is a basal group within thorny *Astragalus* and there are several symplesiomorphies shared by the species belonging to this section. Presence of flattened ribbon-like and papillose hairs, large ligneous pods and a standard not sharply differentiated to claw and limb are some such symplesiomorphies (ZARRE 2000).

This relatively small section is heterogeneous, so the attribution of some species to the section is doubtful. For this reason MAASSOUMI (1995) separated *A. ovigerus* [as a new

species *A. lamprocarpus*] under a new section, namely sect. *Lamprocarpa* Maassoumi. But the correctness of this treatment has been questioned (ZARRE 2000) because of paraphyletic nature of such a classification.

Astragalus sect. *Acanthophace* is closely related to *A.* sect. *Megalocystis* Bunge and sect. *Adiaspastus* Bunge. *A. lalesarensis* Bornm. plays a transitional role between all three sections. Vegetative form and shape of petals in this species are very similar to *A. hezarensis* (sect. *Acanthophace*), while its red colored and inflated fruiting calyx reminds one of *A. murinus* (sect. *Megalocystis*). Moreover, it is similar (and most probably closely related) to *A. sahendi* (sect. *Adiaspastus*) in many respects. The appearance of paraclades on short lateral branches at the base of each leaf is a rare character in the thorny *Astragali* which is developped in *A. sclerocladus* of sect. *Acanthophace*. This character occurs otherwise in sect. *Poterion* Bunge, which is also more or less a basal group within the thorny Astragali (see ZARRE 2000).

This study is mainly based on herbarium material. Several sheets have been examined for each species, received on loan from the following herbaria (abbreviations according to HOLMGREN & al.): B, BM, E, G-BOIS, G-DC, JE, K, M, M, P, IRAN, TARI, TUH, UPS, US, W and WU. Moreover, during several excursions in Iran, some of the species were studied in the field by one of the authors (ZARRE). Flower dissections were made from several specimens and added to the sheets after examination.

Taxonomic Account

Astragalus L sect. ***Acanthophace*** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 45. 1868. Lectotype (DEML 1972): *A. schistocalyx* Bunge.

= *A.* sect. *Lamprocarpa* Maassoumi, Iran. J. Bot. 6: 199. (1994) 1995. Type (monotypic): *A. lamprocarpus* Maassoumi.

Subshrubs or cushion-forming plants, loosely or densely branched at base. Caudex up to 3 cm in diam., greyish brown to black. Hairs mostly flattened and ribbon-like, papillose on surface, white in vegetative parts, mixed with grey and black ones in the inflorescences. Stipules chartaceus, yellowish-white, adnate to petiole for ca. 1/3–1/2 of their length, otherwise free from each other or only shortly connate at the base, triangular-ovate, the free acute tips with only one main nerve. Leaves paripinnate; rhachides thick and rigid, hairy, whitish green; leaflets ± thick, mostly small, green or greyish green, hairy, mostly soon glabrescent, sometimes completely glabrous. Inflorescences lateral, few–10-flowered racemes. Peduncle shorter than leaves, appressed hairy. Bracts chartaceous, with one main nerve. Bracteoles sometimes present, adnate to the calyx, singular or in pairs. Pedicels up to 2.5 mm long. Calyx tubular, chartaceus, with 14–16 parallel indistinct longitudinal, thin nerves, sparsely to densely hairy, ruptured by the pod; teeth subulate. Corolla pink to purple or bluish to violet, more rarely creamy to yellowish, claw of wings and keel only at base adnate to staminal tube. Standard (10–)12–28 mm long, not sharply differentiated into claw and blade, constricted at the middle, lower half narrower than upper. Wings slightly shorter than standard, blade narrowly oblong to narrowly obovate, claw as long as or longer than blade. Keel slightly shorter than wings, blades obovate-triangular, with widely to rectangular-curved lower edge and ± straight upper edge. Ovary shortly stipitate, hairy; style hairy at the base or in lower half. Fruits bilocular, or only in *A. hezarensis* and *A. ovigerus* unilocular, laterally or

dorsi-ventrally compressed, elliptic-oblong to ovate-elliptic or widely elliptic. Seeds olive green to brown with black spots, rugose on surface, elliptic-kidney-shaped.

Diagnostic key to the species of *Astragalus* sect. *Acanthophace*

1. Short lateral shoots present at the base of each leaf on the main stem though irregularly; paraclades borne on the short lateral shoots; calyx hairs exclusively white 8. *A. scleroclad*us Bunge
– Short lateral shoots absent; paraclades borne directly on the main stem; calyx hairs white and black, only in *A. lycioides* some specimens with exclusively white hairy calyx 2
2. Ovary and fruits unilocular; mature fruits 15–38 mm long 3
– Ovary and fruits bilocular; mature fruits 7–15 mm long 4
– Mature fruits 15–18 mm long; leaflets 5–7 pairs; calyx greyish green to creamy 5. *A. hezarensis* Zarre & Podlech
– Mature fruits 30–38 mm long; leaflets 7–10(–15) pairs; calyx often flushed with red 7. *A. ovigerus* Boiss.
4. Young stems ± glabrous; stipules glabrous or only at margins ciliate 5
– Young stems densely hairy; stipules hairy allover 7
5. Bracts linear-subulate, 1.5–2.5 mm long and 0.5–1 mm wide 9. *A. stenostegius* Boiss. & Hausskn.
– Bracts ovate, 2–4 mm long and 1.5–2.5 mm wide 6
6. Leaflets in 4–9 pairs, sparsely to loosely covered on underside with ascending hairs; bracts 2–4 mm long; calyx sparsely to loosely covered with ascending white and black hairs; standard 12–17 mm long; legumes 8–12 mm long 4. *A. horridus* Boiss.
– Leaflets in 6–11 pairs, glabrous or with few appressed hairs at the midvein; bracts 1–2.5 mm long; calyx very sparsely covered with strongly appressed black hairs; standard 16–21 mm long: Legumes 6–7 mm long 1. *A. cryptocarpos* DC.
7. Calyx teeth 1/2–1/1 as long as the tube; standard 11–14 mm long 3. *A. hemsleyi* Aitch. & Hemsl.
– Calyx teeth 1/5–1/3 as long as the tube; standard 14–25 mm long 8
8. Fruits laterally compressed, 2–3 mm wide; young rhachides dense. Standard glabrous 6. *A. lycioides* Boiss.
– Fruits dorsi-ventrally compressed, 5–9 mm wide; young rhachides remote. Standard hairy along the midline on dorsal surface 2. *A. cystosus* Zarre & Podlech

The species

Astragalus cryptocarpos DC., Astragal.: 187. 1802. Holotype: "Tragacantha orientalis humillima foliis viciae, costae purpureae innascentibus, Tournefort cor. 29, Armenia" (P (hb. Vaillant!; iso: G-DC!, LE (fragm.)! [all without flowers and fruits]. Epitype (here designated): Turkey, [B9 Bitlis] Hanemir Da, N Seite von Oboskü Köyü aus, 2320 m, 10.8.1987, *Engel 108a* (MSB!).

= *Astragalus rechingeri* Sirj., Ann. Naturhist. Mus. Wien 49: 269. 1939. Holotype: Kurdistan, Aghérov Da. (S der Ebene von Pesandasht, 2900 m, 24.6.1936, *Frödin 77* (UPS!: photo K; iso: W!: photo MSB!).

Dwarf cushion-forming shrublets, 15–20 cm tall, densely branched at the base, mostly very sparsely furnished with white and black hairs 0.2–1 mm long. Stems from a prostrate base ascending, older parts without remnants of last years stipules and rachides, parts of the current year 1–6 cm long, in first year 1–2.5 mm diam., glabrous below stipules. Stipules whitish, chartaceous, 3–6 mm long, adnate to the petiole for 2-3 mm, otherwise free from each other, triangular- acuminate, glabrous or sometimes with few hairs at the margins. Leaves 1.4–7 cm long; rhachides crowded, ± thin, flexible, straight or curved, glabrous or with few appressed white hairs; terminal spine 1/3–1/1 as long as the uppermost leaflets; petiole 0.6–2.2 cm long (ca. 1/3–1/2 as long as rhachis). Leaflets in 6–11 pairs, green, 3–8 × 0.7–1.5 mm, narrowly oblong, or rarely narrowly obovate, mostly folded, at the apex acute or obtuse, minutely mucronulate, glabrous or on underside with few appressed hairs at the midrib. Peduncles 0.2–0.5 cm long, sparsely covered with some black or rarely mixed with white, ± spreading hairs. Racemes loosely 2–5-flowered; flowering axis 0.2–0.5 cm long. Bracts chartaceous, whitish, 1–2.5 mm long and 0.5–1 mm wide, narrowly triangular-acuminate, deciduous, glabrous or sometimes with few tubercle-based hairs at margins. Pedicels 1–2 mm long, with few subappressed black hairs. Bracteoles absent. Calyx dark grey or brownish becoming creamy, tubular, ruptured by the pod, 6.5–10 mm long and 1.5–3.5 mm diam., very sparsely covered with strongly appressed black hairs, at the teeth more densely hairy and with some white hairs mixed in; teeth (1.5–)3 mm long, subulate. Petals pinkish-white, keel sometimes with bluish violet blades. Standard 16–21 mm long and 5–8 mm wide, without clearly differentiated claw, oblong, shallowly constricted at middle, lower part as wide as the upper part, retuse at the apex. Wings 14–18 mm long; blade narrowly oblong, at the apex obtuse or very minutely mucronulate, 6.5–10 × 2–3 mm; auricle 0.7–1 mm long, claw 8.5–9 mm long. Keel 13–15 mm long; blades ovate-oblong or rarely elliptic, 5–6 × 2.5–3 mm; claw 8.5–9 mm long. Ovary very shortly stipitate, densely sericeous except for base, ventral and dorsal edges; style glabrous. Legumes shortly stipitate, obliquely elliptic with straight ventral edge and strongly curved dorsal edge, 6–7 mm long, 2.5–4 mm wide and 3–5.5 mm high, laterally compressed, with a straight beak 0.5–1 mm long, bilocular; valves sparsely appressed hairy, becoming glabrous. Seeds immature, single in each locule.

Distribution: E Turkey.

Specimens seen:

Turkey: Prov. Bitlis/Van: mt. 10 km SE Pelli, 2450 m, 8.7.1954, *Davis & Polunin D.22582* (BM, E). – Prov. Van: distr. Satak, Kavussahap Dag, 2750 m, 27.7.1954, *Davis & Polunin D.23075* (BM, E) – Tatvan to Geva, Kusgunkiran Geçidi, 2250 m, 11.8.1987, *Engel 110* (MSB).

Note: The type material of *A. cryptocarpos* both in G-DC and P consists only of some sterile shoots, without flowers and fruits. That is the reason why this species was treated as doubtful by BUNGE (1867/68) and BOISSIER (1872). The original description was most probably prepared on the basis of a poor specimen with only one flower and pod. Since the type material associated with this name is ambiguous, it was necessary to select an epitype (see GREUTER & al. 1994, article 9.7) congruent with the original description and material of this name.

After typification it became clear that *A. rechingeri* must be reduced to synonymy under this species. The latter was treated as a member of sect. *Acanthophace* in Flora of Turkey by CHAMBERLAIN & MATTHEWS (in DAVIS, Flora of Turkey 1970) and has been transferred into sect. *Acidodes* Bunge (a synonym of sect. *Adiaspastus* Bunge, see ZARRE 2000) by DEML (1972). The type material of *A. rechingeri* is a young plant without any mature pod. But the new collections of this species by Engel near the type locality confirmed that this species has bilocular fruits, and therefore belongs to the sect. *Acanthophace* sensu DEML (1972) and not to sect. *Acidodes*. Bilocular pods with only one seed in each locule and almost glabrous leaves and stipules are the features which were cited as characteristic in the original descriptions of both *A. cryptocarpos* and *A. rechingeri*. Moreover, there is no other species of *A.* sect. *Acanthophace* distributed in Turkey. Therefore, the synonymy of *A. rechingeri* under *A. cryptocarpos* is well confirmed.

The type material of *A. rechingeri* as well as other specimens belonging to *A. cryptocarpos* show the indumentum type typical for *A.* sect. *Acanthophace*: the hairs are appressed, ribbon-like and densely papillose. As it was mentioned recently (ZARRE 2000), such indumentum is also characteristic for subtribe *Coluteinae* of the tribe *Galegeae*.

Astragalus cystosus Zarre & Podlech, spec. nov.

Holotype: Iran, Prov. Khorassan, Montes Yoghatay in declivibus 25 km N Sabzevar, 1500–1600 m, 16.6.1975, *K.H. Rechinger 53642* (M!; iso: W!).

Figure: Fig. 1.

Valde affinis *A. lycioides* sed differt leguminis dorsi-ventraliter (nec lateraliter) compressis, 5–9 mm (nec 2–3 mm) latis et rhachidibus remotis (nec densis).

Fruticulosus, spinosus, 15–35 cm altus, pilis subbasifixis, albis nigrisque 0,1–1,5 mm longis. Stipulae chartaceae, 1–4 mm longae, triangulares. Folia 1,3–6,5 cm longa; rhachides ± remotae, dense sericeae. Foliola 4–9 juga, 1–4 mm longa et 2–5 mm lata, obovata, retusa, appresse sericea. Racemi pedunculo 0,3–2,2 cm longo, dense appresse pilosi suffulti, laxe 2–6 (–9)-flori. Bracteae chartaceae, anguste triangulares, 1-2 mm longae, dense appresse piloseae. Pedicelli ca. 2 mm longi. Bracteoleae saepe evolutae, minutae. Calyx tubulosus, flavidi-rubellus, 8–13 mm longus, sparse ad dense appresse pilosus. Petala rosea ad violacea.

Vexillum 16–25 mm longum et 5–9 mm latum. Legumina coriacea, bilocularia, valde inflata, dorsi-ventraliter compressa, 10–15 mm longa et 5–9 mm lata.

Dwarf spiny subshrubs, 15–35 cm tall, densely or rarely loosely branched at the base, furnished with mostly flattened and ribbon-like, in vegetative parts white, in inflorescences mostly also black hairs 0.1–1.5 mm long. Stems 1.5–2.5 mm in diam. in first year, densely appressed hairy, gradually glabrescent. Stipules chartaceous, yellowish, mostly reflexed from the middle, 1–4 mm long, adnate to the petiole for ca. 1/2–2/3 their length, triangulate or ± oblong-acuminate, densely hairy, partly glabrescent. Leaves 1.3–6.5 cm long; rhachides ± remote, thin, rigid, densely hairy or partly glabrescent, terminal spine 2–5 times as long as the uppermost leaflets; petiole ca. 1/3 as long as the rhachis. Leaflets in 4–9 pairs, mostly complicate, rarely flattened, greyish green to green, 1–4 × 1–2.5 mm, obovate, at the apex shallowly retuse, on both sides sparsely to densely appressed hairy, partly glabrescent. Peduncles 0.3–2.2 cm long, densely appressed hairy. Racemes loosely 2–6(–9)-flowered. Bracts narrowly triangular, 1-2 mm long, chartaceous, densely appressed hairy. Pedicels ca. 2 mm long, appressed hairy. Bracteoles mostly present at the base of calyx, single or rarely in pairs, ca. 1 mm long, subulate, hairy. Calyx yellowish, sometimes flushed with red, 8–13 mm long and 2–3 mm in diam., sparsely to densely covered with appressed or rarely ascending hairs; teeth 1.5–3 mm long, mostly unequal, subulate. Petals pink to violet. Standard hairy on midrib at the dorsal-abaxial surface, 16–25 mm long and 5–9 mm wide, without sharply differentiated claw, ± elliptic-pandurate, shallowly constricted at the middle, at the apex retuse. Wings slightly shorter than standard; blade narrowly oblong, obtuse at the apex, 7–9 × 2 mm; auricle 0.5–0.8 mm long. Keel 14–19 mm long; blades 5.5–8 × 2–2.5 mm. Legumes with a stipe ca. 1 mm long, 10–15 mm long, 5–9 mm wide and 3–6 mm high, dorsi-ventrally compressed, bilocular; valves coriaceous. Seeds 4–12.
Distribution: NE Iran.

Specimens seen:
Iran. Prov. Khorasan: Esfarayen versus Sabzevar, 20 km from Sabzevar, 1600–1700 m, 27.6.1975, *Termeh s.n.* (IRAN) – Montes Yoghatay in declivibus 25 km N Sabzevar, 1500–1600 m, 16.6.1975, *Rechinger 53642* (M, W).

Note: The material desribed here as the new species "*A. cystosus*" was attributed to *A. pseudoangustifolius* Sirj. & Rech.f. by Maassoumi (1995). Although the specimen cited as the reference for such a treatment (*Assadi & Mozaffarian 35753* in TARI) was also collected from Kuh-e Bizg, like *A. pseudoangustifolius*, it differs in some respects from the type material of the latter species. The most important difference in vegetative parts between *A. cystosus* and the type of *A. pseudoangustifolius* is the loose habit of the former and its remotely positioned rhachides. Since the type material of *A. pseudoangustifolius* is young and lacks any fruit, an epitype was selected for this specimen (see under *A. lycioides*). This epitype falls in all respects, especially with its laterally compressed fruits, within the variability of *A. lycioides*. Therefore, *A. pseudoangustifolius* is reduced here to synonymy under *A. lycioides*. So, there was no name for the species with largely inflated and dorsi-ventrally compressed fruits and it is therefore newly described here.

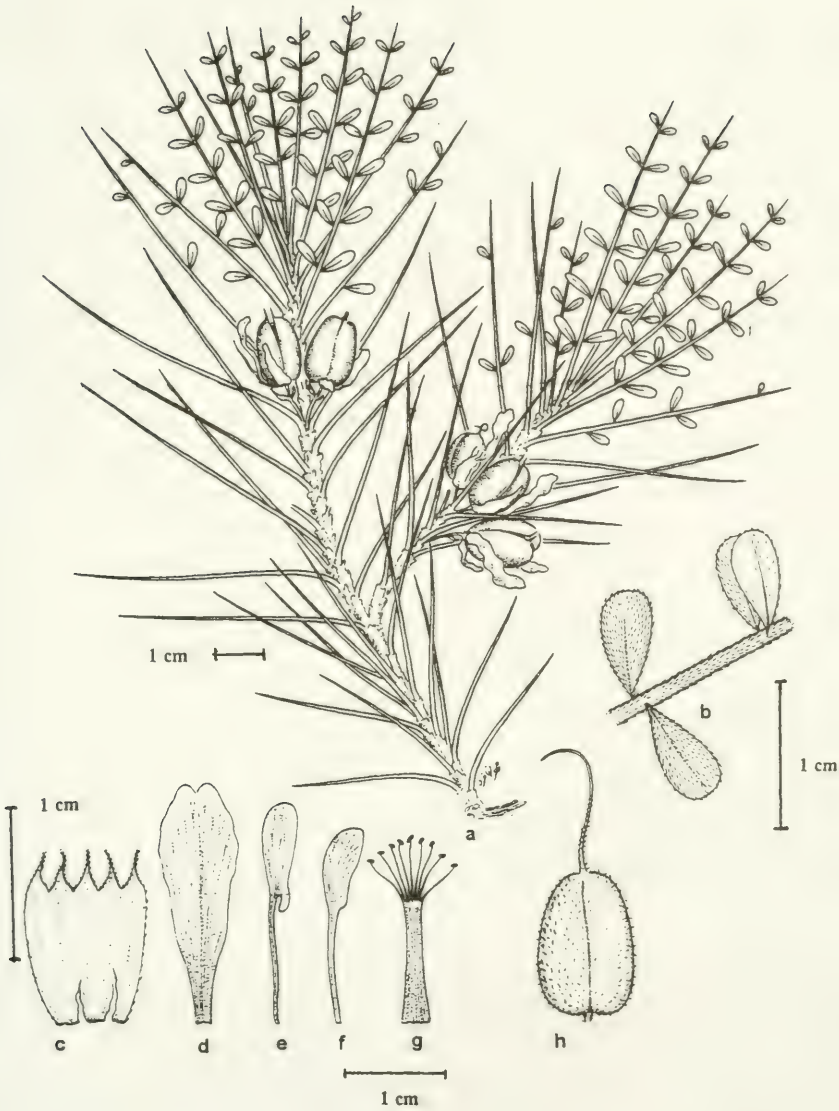

Fig. 1. *Astragalus cystosus* (after *Termeh s.n.*): – a: the whole plant, b: rhachis segment with leaflets, c: calyx, d: standard, e: wing, f: keel, g: staminal tube, h: fruit.

Astragalus hemsleyi Aitch. & Baker, J. Linn. Soc., Bot. 19: 158. 1882 ≡ *A. canispinus* Boiss., Fl. Or. Suppl.: 181. 1888, illeg. [homotypic with *A. hemsleyi*]. Syntypes: [Afghanistan] Hariab District, 1880, *J.E.T. Aitchison 61/80*; dto., Sergal to Biankhel, 5.6.1879, *J.E.T. Aitchison 1215* (K!). Lectotype (Ali 1961): Hariab District, Afghanistan, 1880, *J.E.T. Aitchison 80* (K!; iso sub 61/80: BM!, C!, G-BOIS!, K!, LE!, P!).

Figures: RECHINGER, K.H.: Symbolae Afghanicae 3 – Biol. Skr. 9(3): Fig. 131, 132. 1957; DEML, I.: Revision der Sektionen *Acanthophace* Bunge und *Aegacantha* Bunge der Gattung *Astragalus* L. – Boissiera 21: p. 185, 186, figs. 1, 2 & 25. 1972.

Dwarf spiny subshrubs, 15–25 cm tall, densely or rarely loosely branched at the base with white, only in the calyx also with greyish-black hairs 0.1–0.6 mm long. Stem 1.5–2.5 mm diam. in first year, densely appressed sericeous, gradually glabrescent. Stipules chartaceous, yellowish, 2–4 mm long, adnate to the petiole for ca. 1/2 of their length, triangular or ± oblong-acuminate, sparsely hairy, soon glabrescent, ciliate at margins. Leaves 2–5 cm long; rhachides ± dense, thin, rigid, densely hairy, glabrescent with age; terminal spine 2–4 times as long as the uppermost leaflets; petiole ca. 1/5–1/3 as long as the rhachis. Leaflets in 6–9 pairs, slightly complicate or flat, greyish green to green, 1–3 × 1–2 mm, widely obovate to nearly orbicular, shallowly retuse at the apex, on upper side glabrous, on underside sparsely adpressed hairy, especially at midvein and margins. Peduncles 0.1–0.2 cm long, hairy. Racemes loosely 2–4-flowered. Bracts chartaceous, narrowly triangular, 1–2 mm long, appressed hairy. Pedicel 1–2.5 mm long, hairy. Bracteoles sometimes present at the base of calyx, single or rarely in pairs, 0.2–1 mm long, subulate, hairy. Calyx yellowish-white, mostly flushed with red, 6–9 mm long and 2–3 mm in diam., sparsely to densely covered with appressed to spreading hairs; teeth 2–4.5 mm long, mostly unequal, subulate. Petals pink to red. Standard 10–14 mm long and ca. 5 mm wide, without sharply differentiated claw, ± elliptic-pandurate, shallowly constricted at middle, retuse at the apex. Wings slightly shorter than standard; blade narrowly oblong, obtuse at the apex, 5–6.5 × 2 mm; auricle 0.3–0.4 mm long. Keel 9–10 mm long; blades ca. 4–5 × 2 mm. Legumes with a stipe ca. 0.5 mm long, narrowly elliptic, ca. 8 mm long and 3.5 mm high, laterally compressed, bilocular; valves coriaceous, ± densely covered with appressed to ascending hairs. Seeds 3-8.
Distribution: Afghanistan and Pakistan.

Specimens seen:
Afghanistan. Prov. Paktia: Latakary Pass zwischen Alikhel und Dobandi, 3300 m, 5.7.1991, *Volk 71/489* (MSB) – oberhalb Qasim Khel, 3250 m, 24.6.1969, *Freitag 5772* (Hb. Freitag) – Hariab District, 1880, *Aitchison 61/80* (BM, G-BOIS, K, LE, P) – Sergal to Biankhel, 5.6.1979, *Aitchison 1215* (K).
Pakistan. Kurram: in valle Kurram, 2700–3000 m, *Harsukh 14830* (E). – Quetta: Urak-Tal, 12 Meilen W. Quetta, V.1958, *Repp* (W) – Ziarat, 2440 m, 18.5.1989, *Lace* (E). – Kalat: in monte Harboi pr. Kalat, 2700 m, *R.R. Stewart 772* (E).
??: Surkai Zangy, 19.5.1956, *Peddie 124* (K).

Note: This species is endemic around the Afghanistan-Pakistan border. Another thorny species of *Astragalus* which shows a similar distribution pattern is *A. diopogon* from sect. *Megalocystis*. Since the fruits of the latter sometimes rupture the calyx (see TIETZ & ZARRE 1994), a feature characterizing *A.* sect. *Acanthophace*, it can be confused with *A. hemsleyi*. However, the exclusively white hairy calyx of *A. diopogon* (in contrast to the white and black hairy one in *A. hemsleyi*) and its relatively large bracts (3–9 mm, against 1–2 mm in *A. hemsleyi*) can be used as diagnostic characters for separating them.

Astragalus horridus Boiss., Diagn. pl. orient., ser. 2, 2: 66. 1843 ≡ *Tragacantha horrida* (Boiss.) Kuntze, Revis. Gen. 2: 945. 1891. Syntypes: Asia minor, *Aucher 1253* (P!); Persia prope Ispahan, *Aucher-Eloy 1280*; Persia occidentali,. *Aucher-Eloy 1281* (G-BOIS!: photo M!, K!: foto M!, P!); [Iran] in montibus Ghilani, *Aucher-Eloy 4394* (LE!, P!). Lectotype (DEML 1972): Persia prope Ispahan,. *Aucher-Eloy 1280* (G-BOIS!: foto MSB!; iso: G!, K!: foto M!, LE!, OXF!, P!).

= *A. chionobius* Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11 (16): 46. 1868 [et l.c. 15(1): 74. 1869] ≡ *Tragacantha chionobia* (Boiss.) Kuntze, Revis. Gen. 2: 944. 1891. Lectotype (PODLECH 1998): Persia, Kuh-Delu, 10.6.1842, *Kotschy 474* (P!: foto MSB!; iso: G!, G-BOIS!: foto MSB, K!, M!, P!, ZT!).

= *A. chionobius* var. *hirtus* Boiss., Fl. Or. 2: 313. 1872. Lectotype (PODLECH 1998): [Iran] Esfahan, ad nives Kellal et Sebse Kuh, 1868, *H.C. Haussknecht* (G-BOIS!; iso:G!, K!, W!).

Figures: DEML, I.: Revision der Sektionen *Acanthophace* Bunge und *Aegacantha* Bunge der Gattung *Astragalus* L. – Boissiera 21: p. 183, 186, Fig. 9–12, 16, 17, 22, 23. 1972.

Dwarf spiny subshrubs, 15–35 cm tall, densely or loosely branched at the base with in vegetative parts white, in the inflorescenses mostly also with black hairs 0.1–1 mm long. Stems 1.5–3 mm diam. in first year, glabrous. Stipules membranous, yellowish-white, 3–6 mm long, adnate to the petiole for ca. 2/3 of their length, partly or completely clasping the stem, mostly ovate-acuminate, ciliate at margins and tip, glabrous otherwise. Leaves 1.7–6.5 cm long; rhachides ± dense, thin, rigid, sparsely to loosely furnished with appressed to ascending hairs, glabrescent with age; terminal spine 2–5 times as long as the uppermost leaflets; petiole ca. 1/3 as long as the rhachis. Leaflets in 4–9 pairs, slightly complicate to flat, green, 3–7 × 1–2.5 mm, narrowly obovate, acutish to shallowly retuse at the apex, on upper side hairy only at the margins, on underside very sparsely to loosely furnished with ascending hairs. Peduncles 0.2–0.7 cm long, appressed hairy. Racemes loosely 4–9-flowered. Bracts whitish, membranous, 2–4 mm long and 1.5–2.5 mm wide, ovate, sparsely hairy. Pedicels 1–2 mm long, hairy. Bracteoles sometimes present, at the base of calyx, single or rarely in pairs, 1–2.5 mm long, ciliate. Calyx yellowish, mostly flushed with red, 7–12 mm long and 2–5 mm in diam., sparsely to loosely covered with appressed to ascending black and white hairs; teeth 1.5–3(–4) mm long, mostly unequal, subulate or linear. Petals pink to purple. Standard 12–17 mm long and 4.5–7 mm wide, without clearly differentiated claw, elliptic to ± elliptic-pandurate, somtimes shallowly constricted at middle, retuse at the apex. Wings 11–15 mm long; blade narrowly oblong, obtuse at the apex, 5.5–7 × 2 mm wide; auricle ca. 0.5–0.8 mm long. Keel 10–14 mm long; blades ± semicircular,with widely curved lower edge and straight upper edge, 4–6 × 2–2.5 mm. Ovary densely hairy. Legumes with a stipe 0.5–1 mm long, narrowly elliptic, 8–12 mm long and 3–4 mm high, laterally compressed, bilocular; valves coriaceous. Seeds 4–8.

Distribution: C, W and SW Iran.

Specimens seen:

Iran. Prov. Boyer Ahmadi (Kohgiluyeh): Kuh Dena, 3600 m, ix.1955, *Remaudière 5242* (IRAN). – Prov. Chahar Mahal Bakhtiari: Zard-Kuh, above Kuhrang valley, 4265 m, 5.8.1966, *Archibald 2957* (E, K) – Zard Kuh, 3500–4000 m, 10.8.–3.9.1975, *Carls* (W) – Gandomkar,

Kuh-e Garreh, 2300–2700 m, 9.6.1973, *Iranshahr & Moussavi 15557* (IRAN, W) – Ardal, Zard Kuh, 2700–3200 m, 14.–15.6.1973, *Iranshahr & Moussavi 15599* (W) – Kouhrang Dam, versus Sarcheshmeh Karoun, 2300–2400 m, 18.6.1973, *Iranshahr & Moussavi 15603* (IRAN, W) – Dul-Kala, near Kuhrang, c. 2500 m, 7.6.1966, *Zhumer 1035* (BG). – Prov. Esfahan: prope Ispahan,. *Aucher-Eloy 1280* (G, G-BOIS, K, LE, OXF, P) – Qashqai region, Kuh-e Surmandeh (Kuh-e Alijuq), Semirom, in declivibus boreo-orientalibus, 2700–3900 m, 7.6.1974, *Rechinger 47550* (M, W). – Prov. Fars: Kuh-Delu, 10.6.1842, *Kotschy 474* (G, G-BOIS, K, M, P, ZT). – Prov. Lorestan: in mte. Schuturunkuh, VII.1908, *Strauss* (B) & VIII.1903, *Strauss* (B, K). – Prov. Markazi: Sultanabad, in monten Raswend, 15.7.1892, *Strauss* (B) – dto., VIII.1899, *Strauss* (B) – ibid., 26.7.1903, *Strauss* (B) – dto., 4.7.1909, *Strauss* (B). – Not traced: Djoubulak, IX.1898, *Strauss* (B).

Note: *A. horridus* is endemic to the central Zagros mountain range. Membranous stipules are one of the important diagnostic characters of this species, a character which relates it to *A. chartostegius* Boiss. & Hausskn. of *A.* sect. *Adiaspastus*. Interestingly, the latter is also distributed over the same area, though more frequent. The bilocular ovary and fruit of *A. horridus* (against the unilocular one in *A. chartostegius*) is an important feature which can be used for separating them.

The specimen *Rechinger 47550* differs from other examined material in having spreading-hairy leaves. Moreover, the type of indumentum on calyx shows a considerable variability in this species: some specimens have spreading-hairy calyx and other appressed ones. A similar situation we have regarding *A. lycioides* with respect to *A. schistocalyx*.

The specimen *Iranshahr & Moussavi 15603* differs from other specimens in having a yellowish white corolla and calyx. It is most probably only an albino morph and cannot represent a new taxon.

Astragalus hezarensis Zarre & Podlech, spec. nov.

Holotype: Iran, Prov. Kerman, Kuh-e Hezar, 20 km SW Rayen, NE ridge leading to summit, 3800 m, 1.6.1977, *J.R. Edmonson & A.G. Miller 1574* (W!; iso: E!).

Figures: fig. 2.

Affinis *A. ovigero* sed differt leguminis brevioribus, 15–18 mm (nec 30–38 mm) longis, foliolis 5–7 jugis (nec 7–10 jugis)et calyce griseo-viridi vel lacteo (nec rubello); ab *A. lalesarensis* (sect. *Megalocystis*) pilis albi-nigrisque (nec tantum albis) obtectus et calyce griseo-viridi vel lacteo (nec rubello); ab *A. sahendi* (sect. *Adiaspastus*) stipulis 5–8 mm (nec 13–17 mm) longis, foliolis 1.5–6 mm (nec 13–17 mm) longis, bracteis 3–4 mm (nec 7–10 mm) longis et leguminibus 11–18 mm (nec 9–11 mm) longis.

Plantae suffruticosae, 15–25 cm altae, pilis basifixis albi-nigrisque, 0,5–1,5 mm longis instructae. Stipulae chartacae, 5–8 mm longae, late ovatae, ciliatae. Folia ad 5,5 cm longa. Foliola 5–7-juga, ad 6 mm longa et 3 mm lata, obovato-elliptica, plerumque plana, sparse ad dense appresse sericea. Racemi pedunculo 0,3–1 cm longo suffulti, laxe 1–2-flori. Bracteae membranaceae, 3–4 mm longae et ca. 1,5 mm latae. Bracteoleae minutae. Calyces 11–15 mm longi et 3–5 mm diam., pilis patentibus densiter obtecti, dentibus 2–3 mm longis. Vexillum

22–27 mm longum et 9–12 mm latum. Legumina a latere compressa, coriacea, 11–18 mm longa et 5–8 mm alta, unilocularia.

Dwarf spiny subshrubs, 15–25 cm tall, ± loosely branched at base, with mostly flattened, rarely cylindrical, acute white or in the inflorescences mostly also with black hairs 0.1–1.5 mm long. Stems 1–3 mm diam. in first year, densely appressed hairy, soon glabrescent. Stipules chartaceous, yellowish-white, 5–8 mm long, adnate to the petiole for 1/2–2/3 of their length, widely ovate, shortly acuminate, ciliate at margins and tip, glabrous otherwise. Leaves 1.1–5.5 cm long; rhachides ± dense, thick, rigid, densely appressed hairy, later on partly glabrescent; terminal spine 1/3–1/10 as long as the uppermost leaflets; petiole 1/3–1/2 as long as the rhachis. Leaflets in 5–7 pairs, ± flat, greyish green, 1.5–6 × 1–3 mm, obovate to elliptic, at the apex obtuse, with a minute mucro 0.2–0.8 mm long, on upper side ± glabrous, on underside sparsely to loosely appressed hairy, soon glabrescent. Peduncles 0.3–1 cm long, densely hairy. Racemes loosely 1–2-flowered.. Bracts ± membranous, 3–4 mm long and ca. 1.5 mm wide, narrowly triangular, sparsely hairy. Pedicels 2–3 mm long, hairy. Bracteoles 1.5–2.5 mm long, subulate. Calyx greyish green, sometimes obliquely gibbous at the base, 11–15 mm long and 3–5 mm diam., rather densely covered with spreading hairs; teeth 2–3 mm long, mostly unequal, from a triangular base subulate. Petals white (yellow when dried), keel with purple blades. Standard 22–27 mm long and 9–12 mm wide, without sharply differentiated claw, ± obovate-elliptic, shallowly retuse at the apex. Wings 18–24 mm long; blade narrowly oblong-elliptic, obtuse at the apex, 9–13 × 2.5–4 mm; auricle ca. 0.6–1 mm long. Keel 15–19 mm long; blades oblong-obovate, 7–8 × 4 mm. Ovary shortly stipitate, style hairy in lower third. Legumes shortly stipitate, narrowly oblong-elliptic, 11–18 mm long and 5–7 mm high, laterally compressed, with a beak 2-3 mm long, unilocular; valves sparsely to densely hairy.
Distribution: S Iran (only known from Hezar mountains around Kerman).

Specimens seen:
Iran. Prov. Kerman: Kuh-e Hezar, 20 km SW Rayen, NE ridge leading to summit, 3800 m, 1.6.1977, *J.R. Edmonson & A.G. Miller 1574* (E, W) – Raien, Gharieh-ye Mir-Shady, Kuh-e Hezar, 3000–3450 m, 21.5.1976, *Moussavi 35026* (IRAN, W).

Note: *A. hezarensis* is closely related to *A. lalesarensis* which has been treated as a member of *A.* sect. *Megalocystis* (see TIETZ & ZARRE 1994). No fruiting specimen of *A. lalesarensis* was available to the earlier authors and it is possible that its fruit is also similar to those of *A. hezarensis*. However, the calyx in *A. lalesarensis* is distinctly inflated (a feature characteristic of *A.* sect. *Megalocystis*). *A. hezarensis* is a narrowly endemic species which occurs in the same area as *A. lalesarensis*. The possession of white-hairy, inflated calyces contrary to black and white hairy, non-inflated calyces separates *A. lalesarensis* from *A. hezarensis*. The close relationship between these species is another evidence for affinity of *A.* sect. *Acanthophace* and *A.* sect. *Megalocystis*. Most probably *A.* sect. *Megalocystis* originated several times from earlier species of *A.* sect. *Acanthophace* and is therefore polyphyletic.

A. hezarensis is also very closely related to *A. sahendi* of *A.* sect. *Adiaspastus* (for a detailed description see ZARRE, 2000), but differs from it in having shorter stipules and larger fruits. Moreover, *A. hezarensis* has papillose hairs, against *A. sahendi* with striate hairs. Aditionally, the fruits, stipules and bracts of *A. sahendi* are larger than those of *A. hezarensis*.

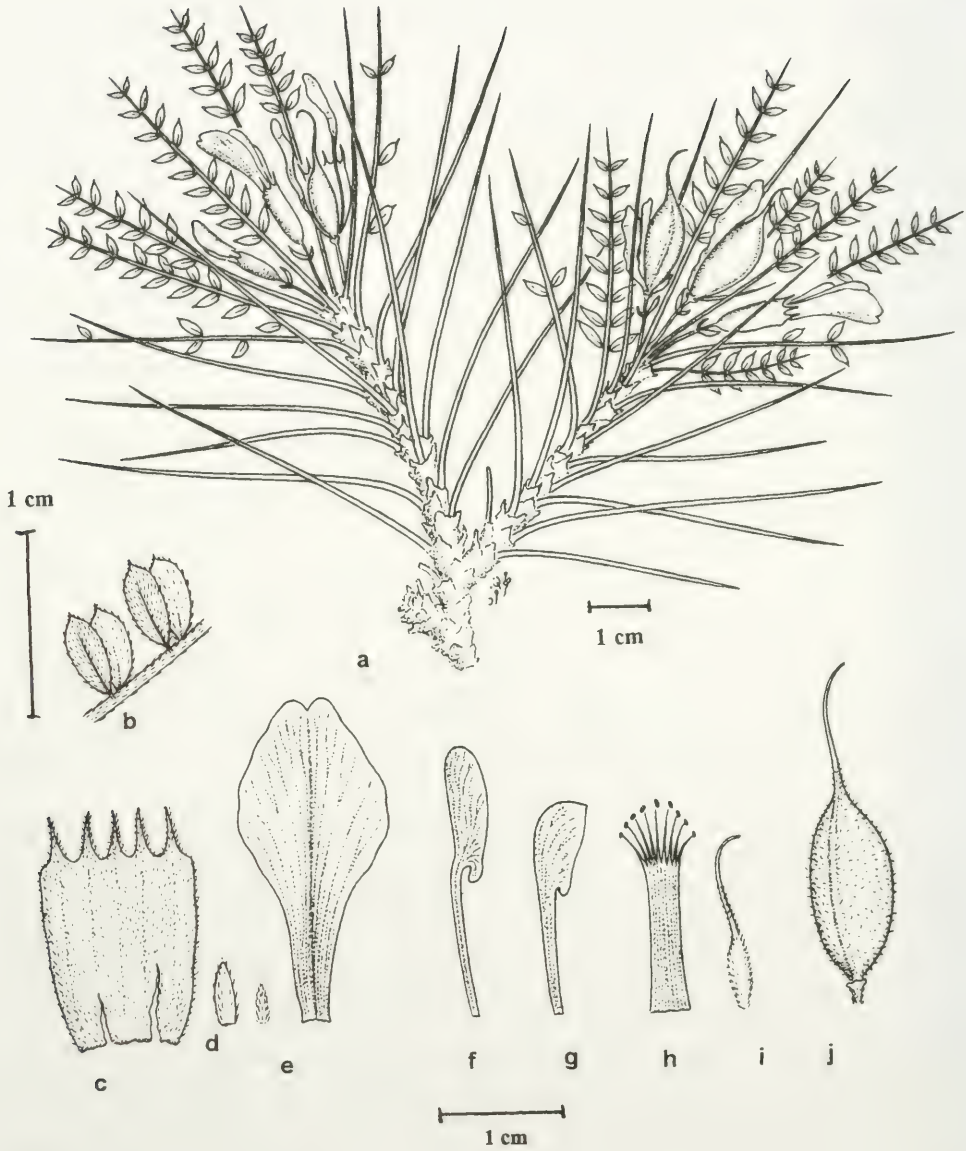

Fig. 2. *Astragalus hezarensis*: – a: the whole plant, b: rhachis segment with leaflets, c: calyx, d: bracts, e: standard, f: wing, g: keel, h: staminal tube, i: ovary, j: fruit. – After *Moussavi 35026* (IRAN).

Astragalus lycioides Boiss., Diagn. pl. orient., ser. 1, 2: 66. 1843 ≡ *Tragacantha lycioides* (Boiss.) Kuntze, Revis. Gen. 2: 946. 1891. Holotype: Persia prope Isfahan, *Aucher-Eloy 1270* (G-BOIS!: foto M!; iso: G!, K!, P!).

= *A. dendridium* Fisch., Bull. Soc. Imp. Naturalistes Moscou 26(2): 427. 1853. Syntypes: M. Sufi pr. Isfahan, *G. Kapherr* (H!); in M. Korud pr. Isfahan, *Bode*. Lectotype (designated here): in m. Korud pr. Isfahan, *Bode* (LE!; iso: G-BOIS!: foto MSB!).

= *A. leptacanthus* Fisch., Bull. Soc. Imp. Naturalistes Moscou 26(2): 432. 1853 ≡ *Tragacantha leptacantha* (Boiss.) Kuntze, Revis. Gen. 2: 946. 1891. Type: Persia, prope Ssof N Isfahan, 22.5.1847, *F.A. Buhse 1450* (iso: G!, G-BOIS!: foto M!).

= *A. schistocalyx* Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 46. 1868 [et l.c. 15(1): 75. 1869]. Syntypes: inter Nischapur et Mesched prov. Chorassan Persiae, fr. 13.7.1856 *A. von Bunge & T. Bienert* (L!, LE!, P!); fl. 12.6.1858, *A. von Bunge & T. Bienert*. Lectotype (PODLECH, 1998): [Iran] inter Nischapur et Mesched prov. Chorassan Persiae, fl., 12.6.1858, *A. von Bunge & T. Bienert* (P!; iso: G-BOIS!, GOET!, K!: photo M!, P!, W!).

= *A. syrtschensis* Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 46. 1868 [et l.c. 15(1): 74. 1869]. Lectotype (designated here): [Iran] Syrtsch inter Chäbbis et Kerman, iv.1859, *A. von Bunge & T. Bienert* (P!; iso: G-BOIS!, GOET!, K!: foto MSB!, L!, LE!, M!, P!: photo M!, W!).

= *A. schistocalyx* var. *bizgimontanus* Sirj. & Rech.f., Ann. Naturhist. Mus. Wien 58: 63. 1951. Holotype: [Iran] Khorasan, in Monte Kuh-e Bizg, 2000 m, *E. Gauba & Mirdamadi 527* (W!). Epitype (designated here): Iran, prov. Khorasan: in monte Kuh-e Bizg, 4.–6.7.1937, *K.H. Rechinger 1442* (W!)

= *A. pseudoangustifolius* Sirj. & Rech.f., Anz. Österr. Akad. Wiss., Math.-Naturwiss. Kl. 90: 119. 1953. Holotype: [Iran] Khorasan, Kuh-e Bizg near Turbat-e Shaik Djam, 17.6.1885, *J.E.T. Aitchison 666* (C!; iso: K!, P!: photo M!, W!). Epitype (designated here): Iran, prov. Khorasan: in monte Kuh-e Bizg, 4.–6.7.1937, *K.H. Rechinger 1442* (W!).

Figures: FISCHER, F.B.: "Synopsis *Astragalorum Tragacantharum*" – Bull. Soc. Imp. Naturalistes Moscou 27, tab. J. 1854; DEML, I.: Revision der Sektionen *Acanthophace* Bunge und *Aegacantha* Bunge der Gattung *Astragalus* L. – Boissiera 21: p. 186, figs. 15, 26 (both as *A. lycioides*) and p. 185, 186, fig. 3, 4 13, 14, 27, 28 (all as *A. schistocalyx*). 1972.

Dwarf spiny subshrubs, 15–35 cm tall, densely or rarely loosely branched at the base with mostly flattened and ribbon-like, in vegetative parts white, in the inflorescence mostly white and black mixed hairs 0.1–1 mm long. Stems 1.5–2.5 mm diam. in first year, densely covered with appressed to ascending hairs 0.1–0.5 mm long, glabrescent with age to glabrous in the next year. Stipules chartaceous, yellowish, mostly deflexed from the middle, 1–4 mm long, adnate to the petiole for ca. 1/2–2/3 of their length, triangular or ± oblong-acuminate, densely covered with appressed to ascending hairs. Leaves 1.3–6.5 cm long; rhachides ± dense, thin, rigid, densely appressed hairy, gradually glabrescent; terminal spine 2–5 times as long as the uppermost leaflets; petiole ca. 1/3 as long as the rhachis. Leaflets in 4–9 pairs, mostly complicate, rarely flat, greyish green to green, 1–4 × 1–2.5 mm, obovate, retuse at the apex, on upperside glabrous or sparsely hairy, on underside more densely hairy. Peduncles 0.3–2.2 cm long, with appressed to ascending hairs. Racemes loosely 2–6(–9)-flowered. Bracts narrowly

triangular, 1–2 mm long, sparsely hairy or only ciliate at the margins. Pedicels ca. 2 mm long, hairy like the peduncle. Bracteoles mostly present at the base of calyx, single or rarely in pairs, 0.5–1.5 mm long, subulate, hairy. Calyx yellowish, often flushed with red, 8–13 mm long and 2–3 mm in diam., sparsely to rather densely covered with appressed to spreading white and greyish-black, rarely only with white hairs up to 1.2 mm long; teeth 1.5–3 mm long, mostly unequal, subulate. Petals pink to violet. Standard hairy on midrib at the dorsal surface, 16–25 mm long and 5–9 mm wide, without sharply differentiated claw, obovate to ± elliptic-pandurate, mostly shallowly constricted at middle, retuse at the apex. Wings (12–)14–21 mm long; blades narrowly oblong, obtuse at the apex, 7–9 × 2 mm; auricle 0.5–0.8 mm long. Keel (11–)14–19 mm long; blades 5.5–8 × 2–2.5 mm. Legumes with a stipe ca. 1 mm long, narrowly elliptic, 10–11(–13) mm long, 2–3 wide and 3–6 mm high, laterally compressed, bilocular; valves coriaceous, densely covered with appressed to spreading hairs. Seeds 4–12.
Distribution: NE, C and S Iran.

Specimens seen:

Iran. Prov. Esfahan: Karkas mts. S Natanz, 2500 m, 28.6.1973, *Andersen & Jensen 7295* (E, L) – inter Isfahan et Teheran, Kohrud, V.1859, *Bunge & Bienert* (K, P) – S Kashan, Kuh-e Karkas, 27.5.1974, *Iranshahr s.n.* (IRAN) – Natanz, 1500 m, 19.5.1975, *Iranshahr 40962* (IRAN, W) – Natanz, above the village Abianeh, 2600 m, 29.7.1993, *Maassoumi & al. 71919* (MSB) – before Meymeh, on the road of Soh (Sof), before Delhor village, 2100 m, 4.9.1993, *Maassoumi & Zarre 72013* (MSB) – Kashan, Kamow, Kuh-e Gar-gash, 2400–3200 m, 5.7.1984, *Moussavi & Tehrani 41584* (W) – Kuh-e Karkas, in saxosis prope stationem Radar, 2880 m, *Rechinger 1974* (M, W) – Kashan, Natanz, 1500 m, *Rechinger 52056* (M, W) – Taleghan, c. 30 km SW Ardestan, 2000 m, 15.5.1974, *Wendelbo & Foroughi 11530* (W) – Kuh-e Karkas, near television mast N side of pass, N Tarq, 2700 m, 14.5.1974, *Wendelbo & Foroughi 11428* (W) – Kuh-e Karkas area, just N Tarq, 15.5.1974, *Wendelbo & Foroughi 11456* (W) – prope Isfahan, *Aucher-Eloy 1270* (G, G-BOIS, K, P) – in m. Korud pr. Isfahan, *Bode* (G-BOIS, LE) – prope Ssof N Isfahan, 22.5.1847, *Buhse 1450* (G, G-BOIS). – Prov. Kerman: Kuh-e Jebal Barez, Kuh-e Sarzeh, 5 km NE Garraghan, E of road from Jiroft to Deh Bakri, 3000–3500 m, 13.6.1977, *Assadi & al. 2131* (E) – in reg. alpina montis Kuh-i Dschupar, 3000–3400 m, 10.6.1892, *Bornmüller 3718* (B, WU) – in monte Kuh-i-Nasr, 3800 m, 4.7.1892, *Bornmüller 3719* (B, G) – in monte Kuh-i Sirdsch, 2700 m, 22.5.1892, *Bornmüller 3720* (B, WU) – in monte Kuh-i Lalesar, 3800–3900 m, 17.7.1892, *Bornmüller 3721* (B) – dto., 2650–3000 m, 24.6.1976, *Moussavi & Tehrani 36794* (IRAN, W) montes Kuh-e Jebal Barez in vicinitate vici Deh Bakri, 1700–2700 m, 2.5.1973, *Soják 3967* (PR) – Syrtsch inter Chäbbis et Kerman, iv.1859, *Bunge & Bienert* (G-BOIS, GOET, K, L, LE, M, P, W). – Prov. Khorasan: Neyshabur, Sheykh Abol-Hassan, Binaloud, 1500–2250 m, 30.–31.7.1976, *Termeh & Tehrani 35139 & 35144* (IRAN, W) – in monte Kuh-e Bizg, 4.–6.7.1937, *Rechinger 1442* (K, W) – in Monte Kuh-e Bizg, 2000 m, *Gauba & Mirdamadi 527* (W) – Kuh-e Bizg near Turbat-e Shaik Djam, 17.6.1885, *J.E.T. Aitchison 666* (C, K, P, W) – environs de Mughan et versant nord de la Kuh-i Binalud, 1900–2300 m, *Schmid 6259* (E, W), *6260* (W) – montes Kuh-e Binalud, ca. 20 km bor.-orient. ab oppido Neyshabur, 2300–2800 m, 14.6.1977, *Soják 7662* (PR) – inter Nischapur et Mesched, fl., 12.6.1858, *Bunge & Bienert* (G-BOIS, GOET, K, P, W). – Prov. Yazd: Shirkuh, 20 km SSW Taft, 2700 m, 25.5.1977, *Aryavand & al. 1427* (E) – Schir Kuh, 3960 m, 24.7.1932, *Balls 138* (K) – Deh-Bala, Shirkuh mt., 3500 m, 21.6.1975, *Foroughi & Assadi 17963* (G) – Taft, Gharieh-ye Hedesh, Deh-bala, Shir-kuh, 2800-3300 m, 10.6.1976, *Moussavi & Tehrani 36789* (IRAN, W) – dto., 2300–2600 m, 12.6.1976, *Moussavi & Tehrani s.n.* (IRAN) – dto. 16.7.1976, *Moussavi & Tehrani 35025* (IRAN, W)

Note: The holotypes of both *A. pseudoangustifolius* and *A. schistocalyx* subsp. *bizgi-montanus* are very young plants without mature fruits. Since the pod structure is very important in *A.* sect. *Acanthophace*, it was necessary to select epitypes as reference material

for these species. The specimen *Rechinger 1442* in W fits in all respects the description of both names and was collected like the others two from the famous NE Iranian mountain "Kuh-e Bizg". Therefore *Rechinger 1442* is selected here as an epitype for both the others.

DEML (1972) gave three differences for separating *A. schistocalyx* from *A. lycioides*: appressed hairs on calyx of *A. schistocalyx* (against spreading ones in the latter), peduncles 1–-3 (–7) mm long (against 5–22 mm long in *A. lycioides*), and racemes with 2–5 flowers (not up to 8 as in *A. lycioides*). However the examined specimens show a high variability in all these characters, which does not support the separation of two species. For example the specimens collected from the area about Natanz and Ardestan (Prov. Esfahan), i.e. *Andersen & Jensen 7295* (E, L), *Rechinger 52056* (M, W) and *Wendelbo & Foroughi 11530* (W), and also a specimen from Prov. Khorassan, namely *Soják 7662* (PR), possess long peduncles up to 12 mm and inflorescences with 8–12 flowers, but appressed calyx hairs. Moreover, some specimens collected from an area near the type locality of *A. lycioides* (Soh), i.e. *Maassoumi & Zarre 72013* (M) and *Wendelbo & Foroughi 11456* (W), show the subappressed type of calyx hairs and are in all other respects intermediate between *A. lycioides* and *A. schistocalyx*. Therefore, the name *A. schistocalyx* is reduced here to synonymy under *A. lycioides*.

Astragalus ovigerus Boiss., Diagn. Pl. orient., ser. 1, 2: 67. 1843 ≡ *Phaca ovigera* (Boiss.) Boiss., Diagn. Pl. orient., ser. 1, 6: 35. 1846. Holotype: Persiae alpibus Zerdkou, *Aucher 1277* (G-BOIS!; iso: BM!, G!, K!, P!).

= *A. lamprocarpus* Maassoumi (1994) 1995: Iran. J. Bot. 6: 199 (1994) 1995. Holotype: [Iran] Lorestan, Ghali Kuh (E of the pass on road Aligodarz-Shoulabad), 3100–3600 m, 1.7.1977, *Runemark & Lazari 26506* (TARI!).

Figures: DEML, I.: Revision der Sektionen *Acanthophace* Bunge und *Aegacantha* Bunge der Gattung *Astragalus* L. – Boissiera 21: p.185, 186, fig. 5, 22-23. 1972.

Dwarf spiny subshrubs, 15–30 cm tall, densely branched at base, with mostly flattened, rarely cylindric-acute, in vegetative parts white, in the inflorescenses white and black or sometimes merely black hairs 0.1–1.5 mm long. Stems of the current year 1–3.5 mm diam., up to 1 cm long, appressed hairy, soon glabrescent. Stipules chartaceous, yellowish-white, 5–8 mm long, adnate to the petiole for 1/2–2/3 of their length, widely ovate-acuminate, densely appressed hairy. Leaves 2–9 cm long; rhachides ± dense, thick, rigid, densely appressed hairy, gradually glabrescent, in the second year glabrous; terminal spine 1/1–3/1 as long as the uppermost leaflets; petiole 1/3–1/2 as long as the rhachis. Leaflets in 7–10(–15) pairs, ± flat, greyish green, 1.5–9 × 1–3 mm, narrowly ovate to narrowly obovate or obovate to elliptic, at the apex obtuse with a minute mucro 0.2–0.8 mm long, on both sides loosely to densely covered with appressed to ascending hairs. Peduncles 1–3 cm long, densely hairy. Racemes loosely 1–3-flowered. Bracts chartaeous, 3–4 mm long and ca. 1.5 mm wide, narrowly triangular, hairy. Pedicels 2–4 mm long, predominantly black hairy. Bracteoles rarely present, ca. 2 mm long, subulate. Calyx greyish green, flushed with red, tubular, 11–14 mm long and 3–5 mm in diam., densely covered with spreading, predominantly black hairs; teeth 1.5–2.5 mm long, triangular. Petals reddish to violet. Standard 22–27 mm long and 8–12 mm wide,

without distinctly differentiated claw, ± obovate-elliptic, scarcely constricted at middle, shallowly retuse at the apex. Wings 18–24 mm long; blade, narrowly oblong, obtuse at the apex, 9–13 × 2.5–4 mm; auricle 0.6–1 mm long. Keel 15–19 mm long; blades oblong-curved, obtuse at the apex, 7–8 × 4 mm. Staminal tube obliquely cut at the mouth, filaments with 6–7 mm long free ends. Ovary shortly stipitate, sparsely hairy; style hairy in lower third. Legumes ovoid, 30–37 mm long, carinate ventrally, shallowly grooved dorsally, shortly acuminate at the apex, sparsely hairy to glabrescent, unilocular.

Specimens seen:

Iran. Prov. Chahar Mahal Bakhtiari: Persiae alpibus Zerdkou, *Aucher 1277* (BM, G, G-BOIS, K, P). – Prov. Lorestan: Kuh-i-Shuturan, 2440 m, 26.5.1941, *Koelz 17824* (US) – Ghali Kuh (E of the pass on road Aligodarz-Shoulabad), 3100–3600 m, 1.7.1977, *Runemark & Lazari 26506* (TARI!).

Note: The holotype of *A. lamprocarpus* was only for a short time available for investigation and therefore no detailed analysis could be made. Nevertheless no differences could be found between it and *A. ovigerus*. Moreover, the specimen *Koelz 17824* (US) was collected from the same area as the holotype of *A. lamprocarpus* and agrees with *A. ovigerus*. In the original description (MAASSOUMI 1994), *A. lamprocarpus* is not compared with *A. ovigerus*, but it fits in all respects the description of the latter.

A. ovigerus and *A. hezarensis* are the only species of *A.* sect. *Acanthophace* which possess unilocular pods. Moreover, their fruits represent the larger ones within the section. However, these features are not enough to separate them as a section distinct from *A.* sect. *Acanthophace* as MAASSOUMI (1995) did with *A.* sect. *Lamprocarpa*. For a more detailed discussion see ZARRE (2000: page 22).

A. ovigerus is a paleoendemic species which shows a disjunct distribution pattern. Moreover, the species is very rare in the distribution area and does not form dense populations.

Astragalus sclerocladus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 46. 1868 [et l.c. 15(1): 75. 1869] ≡ *Tragacantha scleroclada* (Boiss.) Kuntze, Revis. Gen. 2: 947. 1891 ≡ *A. schistocalyx* Bunge subsp. *scleroclad*us (Bunge) I.Deml, Boissiera 21: 34. 1972. Syntypes: env. de Kohrud, *C.P. Bélanger 693* (P!); inter Sof et Kohrud, v.1859, *A. von Bunge & T. Bienert*. Lectotype (PODLECH 1998): [Iran] inter Sof et Kohrud [inter Isfahan et Teheran], v.1859, *A. von Bunge & T. Bienert* (P!: photo MSB!; iso: G-BOIS!, GOET!, K!: photo MSB!, L!, LE!, W!).

Spiny shrubs, 20-60 cm tall, densely or rarely loosely branched at the base with mostly flattened and ribbon-like, only white hairs 0.1–0.8 mm long. Stems 1.5–3 mm diam. in the first year, densely appressed hairy, glabrescent with age. Stipules chartaceous, yellowish, mostly reflexed from the middle, 1–2 mm long, adnate to the petiole for ca. 1/2 of their length, widely triangular-acuminate, densely appressed hairy. Leaves 0.5–4 cm long; rhachides ± remote, thick, rigid, densely hairy, sericeous, gradually glabrescent and glabrous in the second year; terminal spine 1–3 times as long as the uppermost leaflets; petiole ca. 1/4–1/3 as long as the rhachis. Leaflets 3–6 pairs, mostly flat, greyish green to light green, 3–8 × 2–5 mm, obovate

to orbicular or subcordate, rarely narrowly obovate, retuse at the apex, sparsely appressed hairy, especially at the midrib and the margins, soon glabrescent. Peduncles 0.1–0.5 cm long, densely appressed hairy. Racemes loosely 2–6-flowered. Bracts narrowly triangular ovate, 1–2 mm long and 0.7–1 mm wide, chartaceous, densely appressed hairy. Pedicels 1–2 mm long, hairy. Bracteoles rarely present, in pairs at the pedicel, ca. 0.8 mm long, subulate, hairy. Calyx yellowish, mostly fushed with red in upper part, 6–9 mm long and 2–4 mm in diam., sparsely to rather densely appressed white hairy; teeth 1–3 mm long, mostly unequal, subulate. Petals pink to red. Standard 12–18 mm long and 5–6.5 mm wide, without sharply differentiated claw, ± elliptic-pandurate, mostly shallowly constricted at middle, retuse at tip. Wings slightly shorter than standard; blade narrowly oblong, obtuse at the apex, 6–8.5 × 2 mm; auricle 0.4–0.6 mm long. Keel 10–14 mm long; blades 5–6.5 × 2–2.5 mm. Legumes shortly stipitate, elliptic, 6–8(–10) mm long and ca. 4 mm high, laterally compressed, bilocular; valves coriaceous, densely appressed hairy. Seeds 3–9.

Specimens seen:

Iran. Prov. Esfahan: Kuh Barsuk, Kohrud-Gebirge, 27.6.1906, *Strauss* (B) – In m. Kuh-i Kohrud, 10.5.1908, *Bornmüller* (B) – env. de Kohrud, *C.P. Bélanger 693* (P) – inter Sof et Kohrud [inter Isfahan et Teheran], V.1859, *Bunge & Bienert* (G-BOIS, GOET, K, L, LE, P, W) – Kashan, Niassar, 23.5.1970, *Iranshahr 14662* (IRAN) – ca. 2 km from deviation of Ghamsar, on the road to Ghohrud, 1800 m, 4.9.1993, *Maassoumi & Zarre 72018* (MSB, TARI) – In m. Kashan, on the road to Ghohrud, 12 km to Ghohrud, 2150 m, 11.3.1990, *Zarre 69116* (MSB, TARI).

Note: *A. scleroclad*us is a narrowly endemic species known only from the submontane regions around Ghohrud village south of Kashan (centre of Iran). In this region *A. scleroclad*us forms relatively dense populations and is one of the dominant species. This species has been reduced to subspecies rank by DEML (1972), in spite of considerable differences between the two taxa. In ist vegetative form, *A. scleroclad*us is the largest species of *A.* sect. *Acanthophace*. Moreover, it is the only species of the section whose paraclades are borne on the short lateral branches and not directly on the main stem: a character which relates this species to *A.* sect. *Poterion* Bunge (another basal section within the thorny *Astragali*). Beside these features, the obovate and deeply retuse leaflets of *A. scleroclad*us separate it from *A. lycioides*. Because of the above, MAASSOUMI's (1994) opinion in considering *A. scleroclad*us as a distinct species from *A. lycioides* is well supported.

Astragalus stenostegius Boiss. & Hausskn., Fl. Or. 2: 314. 1872 ≡ *Tragacantha stenostegia* (Boiss.) Kuntze, Revis. Gen. **2**: 948. 1891. Lectotype (designated here; DEML 1972 as holotype): [Iran/Iraq] Mt. Avroman et Schahu Kurdistaniae, 1000–12000', VII.1867, *H.C. Haussknecht* (G-Boiss!: photo MSB!; iso: G-BOIS!: photo MSB!, JE!, K!, P!).

= *A. spinellus* Boiss. & Hausskn., Fl. Or. 2: 315. 1872 ≡ *Tragacantha spinella* (Boiss.) Kuntze, Revis. Gen. **2**: 948. 1891. Holotype: [Iran/Iraq] Mt. Avroman et Schahu Carduchiae Persiae, VII.1867, *H.C. Haussknecht* (G-Boiss!: photo K, MSB!).

Figures: DEML, I., Revision der Sektionen *Acanthophace* Bunge und *Aegacantha* Bunge der Gattung *Astragalus* L. – Boissiera 21: p. 185, 186, Fig. 6–8, 19 & 24. 1972.

Dwarf spiny subshrubs, 15–35 cm tall, densely or loosely branched at the base with mostly flattened, ribbon-like, in vegetative parts white, in the inflorescens mixed with black hairs 0.1–1 mm long. Stems 1.5–2.5 mm diam. in first year, glabrous. Stipules membranous, yellowish-white, 3–6 mm long, adnate to the petiole for ca. 1/2 of their length, narrowly triangular, ciliate at margins and apex, glabrous otherwise. Leaves 1.7–4 cm long; rhachides ± dense, thin or rarely thick, rigid, densely covered with appressed to spreading hairs up to 0.8 mm long, glabrescent with age and glabrous in the next year; terminal spine 1–3 times as long as the uppermost leaflets; petiole ca. 1/3 as long as the rhachis. Leaflets in 4–7 pairs, slightly complicate to flat, green, 3–8(–10) × 1–2.5 mm, narrowly ovate to narrowly obovate, at the apex rounded to shallowly retuse, on both sides sparsely ± appressed hairy. Peduncles 0.2–1 cm long, with appressed to spreading hairs. Racemes loosely 3–6-flowered. Bracts narrowly triangular to subulate, 1.5–2.5 mm long and 0.5–1 mm wide, membranous, sparsely white hairy. Pedicels 1–1.5 mm long, hairy. Bracteoles absent. Calyx yellowish, sometimes flushed with red, 5–9 mm long and 1.5–3 mm diam., tubular-campanulate, densely covered with spreading hairs up to 1 mm long; teeth 1.5–3 mm long, mostly unequal, subulate or linear. Petals pink to violet. Standard 10–13 mm long and 4–5 mm wide, without sharply differentiated claw, ± elliptic-pandurate to obovate, mostly shallowly constricted at middle, retuse at the apex. Wings 8–11 mm long; blades narrowly oblong, obtuse at the apex, 4.5–6 × ca. 1.5 mm; auricle 0.3–0.6 mm long. Keel 7–9 mm long; blades ca. 4.5 × 2 mm. Legumes (immature), ca. 8–10 mm long, laterally compressed, bilocular.

Specimens seen:

Iran. Prov. Hamadan: In monte Elwend, VI.1902, *Strauss* (B). – Prov. Kordestan: Mt. Avroman et Schahu Kurdistaniae, 3050–3650 m, VII.1867, *Haussknecht* (G-BOIS, JE, K, P). – Prov. Lorestan: In m. Kuh-i Gerru, VII.1902, *Strauss* (B, JE) – dto., 2.8.1908, *Strauss* (B, JE, P, WU). – Prov. Markazi: in m. Raswend, VIII.1899, *Strauss* (B).

Note: The collection of *Strauss* from Monte Elwend (B) differs from other specimens in having more robust and longer spines, larger calyx (9–13 mm long) and standard 20–24 mm long. Moreover, the calyx is exclusively black hairy in this specimen, in contrast to other examined sheets with high proportion of white hairs too. The shape and size of bracts, however, match the type of *A. stenostegius*. More material and studies are needed for the final systematic positioning of this specimen. Most probably it is a representative of a new taxon.

Deml (1972) expressed her doubt on the identity of *A. spinellus* and *A. stenostegius*. The type material of both species, which was collected from the borders between Iran and Iraq and probably from the same locality, shows only one difference regarding the size of leaves which are very small in *A. spinellus*. The material collected by *Strauss* from Kuh-i Gerru (near Nehawend, W Iran) in both herbaria B and JE is intermediate in this respect and therefore *A. spinellus* is reduced here to synonymy.

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Dr. Shahin ZARRE, Department of Biology, Faculty of Sciences, Tehran University, Enghelab Ave., Tehran, Iran.

Prof. Dr. Dietrich PODLECH: Institut für Systematische Botanik der Ludwig-Maximilians-Universität München, Menzingerstr. 67, D-80638 München, Germany.

New taxa and new combinations published in Sendtnera 7 (31.8.2001)

Aaronsohnia pubescens (Desf.) Bremer & Humphries subsp. ***maroccana*** (Ball) Förther & Podlech, comb. nov.
Astragalus angorensis Podlech, nom. nov.
Astragalus anguranensis Podlech & Maassoumi, spec. nov.
Astragalus argentocalyx [Ali ex] Podlech, spec. nov.
Astragalus austrotibetanus Podlech & L.R.Xu, spec. nov.
Astragalus bashmaghensis Maassoumi & Podlech, spec. nov.
Astragalus behbehanensis Podlech, spec. nov.
Astragalus bingoellensis Podlech, spec. nov.
Astragalus bozakmanii Podlech, spec. nov.
Astragalus bradosticus Maassoumi & Podlech, spec. nov.
Astragalus cobresiiphila Podlech & L.R.Xu, spec. nov.
Astragalus conaensis Podlech & L.R.Xu, spec. nov.
Astragalus cystosus Zarre & Podlech, spec. nov.
Astragalus damxungensis Podlech & L.R.Xu, spec. nov.
Astragalus dickoreí Podlech & L.R.Xu, spec. nov.
Astragalus doabensis Podlech, spec. nov.
Astragalus doghrunensis Maassoumi & Podlech, spec. nov.
Astragalus fruticulosus Podlech, spec. nov.
Astragalus hezarensis Zarre & Podlech, spec. nov.
Astragalus keredjensis Podlech, nom. nov.
Astragalus L. sect. ***Pseudotapinodes*** Podlech & L.R.Xu, sect. nov.
Astragalus lanzhouensis Podlech & L.-R.Xu, spec. nov.
Astragalus maowensis Podlech, & L.R.Xu, nom. nov.
Astragalus marivanensis Podlech & Maassoumi, spec. nov.
Astragalus montis-karkasii Podlech, spec. nov.
Astragalus obtusifoliolus (S.B.Ho) Podlech & L.R.Xu, comb. nov.
Astragalus olurensis Podlech, spec. nov.
Astragalus owirensis [Ali ex] Podlech, spec. nov.
Astragalus parrisii Podlech, nom. nov.
Astragalus poluninii Podlech, spec. nov.
Astragalus pravitzii Podlech, spec. nov.
Astragalus pseudopersicus Podlech & Maassoumi, spec. nov.
Astragalus pseudotauricola (Ponert) Podlech, comb. et stat. nov.
Astragalus qoturensis Podlech, spec. nov.
Astragalus rasmontii Podlech, spec. nov.
Astragalus recurvatus Podlech, spec. nov.
Astragalus rhododendrophila Podlech & L.R.Xu, spec. nov.
Astragalus saadatabadensis Podlech, spec. nov.
Astragalus sata-kandaoensis Podlech, spec. nov.
Astragalus sherriffii Podlech, spec. nov.
Astragalus spitzenbergeri Podlech, spec. nov.
Astragalus tecti-mundi Freyn subsp. ***orientalis*** Podlech, subsp. nov.
Astragalus tibeticola Podlech, spec. nov.
Astragalus tsangpoensis Podlech & L.R.Xu, spec. nov.
Astragalus wakhanicus Podlech, spec. nov.
Astragalus zaraensis Podlech, spec. nov.
Centaurea pungens Pomel subsp. ***austromaroccana*** Förther & Podlech, subspec. nov.
Drimia maritima (L.) W.T.Stearn subsp. ***maura*** (Maire) Förther & Podlech, comb. nov.
Erodium maroccanum (Maire) Förther & Podlech, comb. nov.
Hyacinthoides hispanica (Mill.) Rothm. subsp. ***algeriensis*** (Batt.) Förther & Podlech, comb. et stat. nov.

Limonium bollei (Wangerin) Erben, comb. nov.
Limonium capitis-eliae Erben, spec. nov.
Limonium caralitanum Erben, spec. nov.
Limonium carisae Erben, spec. nov.
Limonium comosum Erben, spec. nov.
Limonium fesianum Erben, spec. nov.
Limonium malfatanicum Erben, spec. nov.
Limonium multifurcatum Erben, spec. nov.
Limonium portovecchiense Erben, spec. nov.
Passiflora tina R.Boender & T.Ulmer, spec. nov.
Pulicaria antiatlantica Förther & Podlech, spec. nov.
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  – Nadeln 3–8 cm lang 3

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